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(71) Applicant: **Availink, Inc.**
Germantown MD 20874 (US)

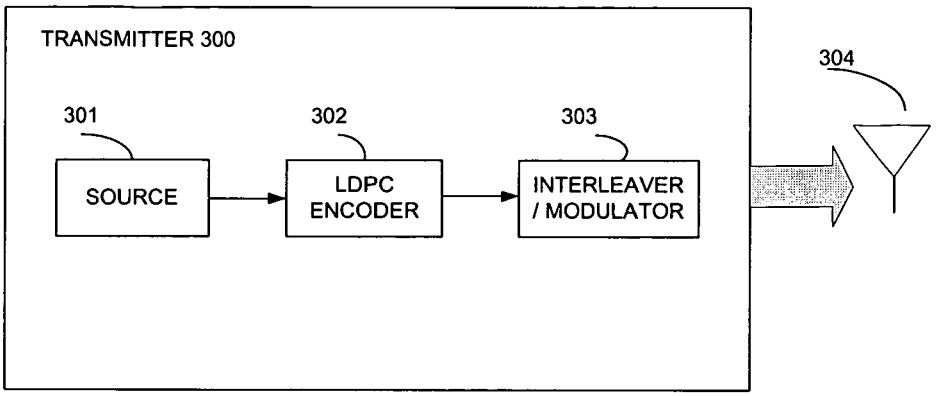
(72) Inventors:
- **Yang, Ming**
  100038 Beijing (CN)
- **Sun, Fengwen**
  Germantown, MD 20874 (US)
- **Zhang, Juntan**
  North Potomac, MD 20878 (US)
- **Shi, Yuhai**
  100045 Beijing (CN)

(74) Representative: **Plougmann & Vingtoft A/S**
Sundkrogsgade 9
2100 Copenhagen (DK)

(54) A family of LDPC codes for video broadcasting applications

(57) A family of quasi cyclic irregular low-density parity-check codes for video broadcasting applications. The parity check matrices of the constructed low density parity check codes have quasi-cyclic structures to facilitate hardware implementation and have proper check/bit degree distributions to offer frame error rate performance lower than 10^{-7}.

FIG. 3



EP 1 901 433 A1

Description

FIELD OF THE INVENTION

[0001] The invention relates generally to error-correcting codes (ECC), and more particularly to a family of low-density parity-check (LDPC) codes for video broadcasting applications.

BACKGROUND OF THE INVENTION

[0002] The growth of broadband services has been fueled by consumers' demands for greater and greater data rates to support streaming video applications. Communication service providers therefore require an infrastructure that can support high data rates in bandwidth limited systems. Unfortunately, coding schemes employed in conventional video broadcasting systems can only provide relatively low throughput. Therefore, there is a need for a video broadcasting system that uses powerful LDPC codes to support higher date rates for the same bandwidth and power, without introducing greater complexity.

[0003] A fundamental problem in the field of data storage and communication is the development of efficient error-correcting codes. The mathematical foundations of error correction were established by Shannon. The most fundamental work of Shannon is the concept of noisy channel capacity, which defines a quantity that specifies the maximum rate at which information can be reliably transmitted through the channel. This capacity is called Shannon capacity. One of the most important research areas in information and coding theory is to devise coding schemes offering performance approaching Shannon capacity with reasonable complexity. Recently, a considerable interest has grown in a class of codes known as LDPC codes due to their feasible iterative decoding complexity and near-Shannon capacity performance.

[0004] In 1993, similar iterative methods were shown to perform very well for a new class of codes known as "turbo-codes." The success of turbo-codes was partially responsible for greatly renewed interest in LDPC codes and iterative decoding methods. There has been a considerable amount of recent work to the analysis and the iterative decoding methods for both turbo-codes and LDPC codes. For instance, a special issue of the IEEE Communications Magazine was devoted to this work in August 2003 (see T. Richardson and R. Urbanke, "The Renaissance of Gallager's Low-Density Parity Check Codes," IEEE Communications Magazine, vol. 41, pp. 126-131, August 2003, and C. Berrou, "The Ten-Year-Old Turbo Codes are entering into Service," IEEE Communications Magazine, vol. 41, pp. 110-117, August 2003).

[0005] LDPC codes were first described by Gallager in the 1960s. LDPC codes perform remarkably close to Shannon limit. A binary *(N, K)* LDPC code, with a code length *N* and dimension *K,* is defined by a parity check matrix **H** of (*N-K*) rows and *N* columns. Most entries of the matrix **H** are zeros and only a small number the entries are ones, hence the matrix **H** is sparse. Each row of the matrix **H** represents a check sum, and each column represents a variable, e. g., a bit or symbol. The number of 1's in a row or a column of the parity check matrix **H** is called the weight of the row or the column. The LDPC codes described by Gallager are regular, i. e., the parity check matrix **H** has constant-weight rows and columns.

[0006] Regular LDPC codes can be extended to irregular LDPC codes, in which the weights of rows and columns vary. An irregular LDPC code is specified by degree distribution polynomials *v(x)* and *c(x)*, which define the variable and check node degree distributions, respectively. More specifically, let

$$v(x) = \sum_{j=1}^{d_{v\max}} v_j x^{j-1} , \qquad (1)$$

and

$$c(x) = \sum_{j=1}^{d_{c\max}} c_j x^{j-1} , \qquad (2)$$

where the variables $d_{v\max}$ and $d_{c\max}$ are a maximum variable node degree and a check node degree, respectively, and $V_j(C_j)$ represents the fraction of edges emanating from variable (check) nodes of degree *j.* The bit and check nodes degree distributions of an irregular LDPC code can also be described by specifying the numbers of bit or check nodes

with different degrees. For instance, an irregular LDPC code with bit node degree distribution $(b_i, b_j) = (N_i, N_j)$ contains N_i and N_j bit nodes with degree b_i and b_j, respectively. While irregular LDPC codes can be more complicated to represent and/or implement, it has been shown, both theoretically and empirically, that irregular LDPC codes with properly selected degree distributions outperform regular LDPC codes. FIG. 5 illustrates a parity check matrix representation of an exemplary irregular LDPC code of codeword length six.

[0007] LDPC codes can also be represented by bipartite graphs, or Tanner graphs. In a Tanner graph, one set of nodes called variable nodes (or bit nodes) corresponds to the bits of the codeword and the other set of nodes called constraints nodes (or check nodes) corresponds the set of parity check constraints which define the LDPC code. Bit nodes and check nodes are connected by edges. A bit node and a check node are to be neighbors or adjacent if they are connected by an edge. Generally, it is assumed that a pair of nodes is connected by at most one edge.

[0008] FIG. 6 illustrates a bipartite graph (Tanner graph) representation of the irregular LDPC code illustrated in FIG. 5. The LDPC code represented by FIG. 6 is of codeword length 6 and has 4 parity checks. As shown in FIG. 5, there are totally 9 ones in the parity check matrix representation of the LDPC code. Therefore in the Tanner graph representation shown in FIG. 6, 6 bit nodes 601 are connected to 4 check nodes 602 by 9 edges 603.

[0009] LDPC codes can be decoded in various ways such as majority-logic decoding and iterative decoding. Because of the structures of their parity check matrices, LDPC codes are majority-logic decodable. Although majority-logic decoding requires the least complexity and achieves reasonably good error performance for decoding some types of LDPC codes with relatively high column weights in their parity check matrices (e. g. Euclidean geometry LDPC and projective geometry LDPC codes), iterative decoding methods have received more attention due to their better performance versus complexity tradeoffs. Unlike majority-logic decoding, iterative decoding processes the received symbols recursively to improve the reliability of each symbol based on constraints that specify the code. In the first iteration, the iterative decoder only uses the channel output as input, and generates reliability output for each symbol. Subsequently, the output reliability measures of the decoded symbols at the end of each decoding iteration are used as inputs for the next iteration. The decoding process continues until a certain stopping condition is satisfied. Then final decisions are made based on the output reliability measures of the decoded symbols from the last iteration. According to the different properties of reliability measures used at each iteration, iterative decoding algorithms can be further divided into hard decision, soft decision and hybrid decision algorithms. The corresponding popular algorithms are iterative bit-flipping (BF), belief propagation (BP), and weighted bit-flipping (WBF) decoding, respectively. Since the BP algorithm has been proven to provide maximum likelihood decoding given that the underlying Tanner graph is acyclic, it becomes the most popular decoding method.

[0010] Belief propagation for LDPC codes is a type of message passing decoding. Messages transmitted along the edges of the graph are log-likelihood ratio (LLR) $\log\frac{p_0}{p_1}$ associated with variable nodes corresponding to codeword bits. In this expression p_0 and p_1 denote the probability that the associated bit takes value 0 and 1, respectively. BP decoding has two steps, a horizontal step and a vertical step. In the horizontal step, each check node c_m sends to each adjacent bit b_n a check-to-bit message which is calculated based on all bit-to-check messages incoming to the check c_m, except the one from bit b_n. In the vertical step, each bit node b_n sends to each adjacent check node c_m a bit-to-check message which is calculated based on all check-to-bit messages incoming to the bit b_n except the one from check node c_m. These two steps are repeated until a valid codeword is found or the maximum number of iterations is reached.

[0011] Because of its remarkable performance with BP decoding, irregular LDPC codes are among the best for many applications. Various irregular LDPC codes have been accepted or are being considered for various communication and storage standards, such as DVB-S2/DAB, wireline ADSL, IEEE 802.1 In, and IEEE 802.16 [4][5]. While considering applying irregular LDPC codes to video broadcasting systems, one often encounters a problem related to error floor.

[0012] The error floor performance region of an LDPC decoder can be described by the error performance curve of the system. The LDPC decoder system typically exhibits a sharp decrease in error probability as the quality of the input signal improves. The resulting error performance curves are conventionally called a waterfall curve and the corresponding region is called a waterfall region. At some point, however, the decrease of error probability with input signal quality increase decreases. The resulting flat error performance curve is called the error floor. FIG. 7 illustrates an exemplary frame error rate (FER) performance curve containing waterfall 701 and error floor regions 702 of an irregular LDPC code.

[0013] Most video broadcasting systems require an FER as low as 10^{-7}. While given codeword length of practical interest (less than 20k) and power constraint, most irregular LDPC codes exhibit error floor higher than 10^{-6}, which is too high for video broadcasting applications.

[0014] LDPC codes have been used in the digital video broadcasting second generation applications (DVB S2). The first generation DVBS was introduced as a standard in 1994 and is now widely used for video broadcasting throughout the world. The ECC used in DVBS is concatenated convolutional and Reed-Solomon codes which is considered not powerful enough. Therefore in 2002 DVB S2 Project called for new coding proposals which are capable of offering 30%

throughput increase for the same bandwidth and power. After examining more than 7 candidates proposed by worldly renowned research labs and companies in terms of performance and hardware complexity, the committee chose a solution based on LDPC codes which provides more than 35% throughput increase with respect to DVBS. Therefore, the LDPC codes used in the DVBS2 standard are widely considered as state-of-the-art. In comparison to the LDPC codes in the DVBS2 standard, the family of LDPC codes in the invention has two advantages. First, the codeword length of the LDPC codes in the invention is 15360, which is much shorter than 64800, and 16200, which are the codeword lengths of the normal and the short LDPC codes in the standard DVBS2, respectively. It is well known in the ECC area that, the longer the codeword length of an LDPC code, the better the asymptotic performance the LDPC code can offer (T. Richardson, M. Shokrollahi, and R. Urbanke, "Design of capacity-approaching irregular low-density parity-check codes," IEEE Trans. Inf. Theory, vol. 47, pp. 619-637, Feb. 2001). Nevertheless the LDPC codes in the invention can provide similar performance as the longer LDPC codes in the DVBS2 standard. It is also known that, from the application perspective, hardware implementation favors shorter LDPC codes which cause less design trouble and less hardware cost. The second advantage is, the LDPC codes in the invention can offer an FER lower than 10^{-7}, which is required by video broadcasting application. By contrast, the LDPC codes in the DVBS2 standard can not provide an FER lower than 10^{-7} by themselves, therefore, outer BCH codes are concatenated to the LDPC codes as outer error correcting techniques to lower the error floor. It is well known in the ECC area that, the shorter the codeword length of an LDPC code, the higher the probability the LDPC code exhibits a higher error floor. Nevertheless, without any aid of concatenated codes and with much shorter codeword length, the LDPC codes in the invention alone can provider an FER lower than 10^{-7}.

SUMMARY OF THE INVENTION

[0015] It is an object of the invention to present improved digital communications transmitter and reciever. This object is achieved by the subject matter of the independent claims. The invention is directed to a family of irregular LDPC codes with different code rates and practical codeword length which can provide error performance with error floor lower than 10^{-7}.

[0016] The invention is directed to irregular LDPC codes of code rates ranging from 1/4 to 9/10. The techniques of the invention are particularly well suited for video broadcasting applications.

[0017] The LDPC codes in the invention can offer a FER performance with error floor lower than 10^{-7}, therefore they can meet the error correcting requirements of video broadcasting applications.

[0018] At the same time, with carefully selected check and bit node degree distributions and Tanner graph constructions, the LDPC codes in the invention have good threshold which reduce transmission power for a given FER performance.

[0019] The threshold of an LDPC code is defined as the smallest SNR value at which as the codeword length tends to infinity, the bit error probability can be made arbitrarily small.

[0020] Furthermore, the quasi-cyclic structure of the LDPC codes in the invention simplify hardware implementation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The invention is illustrated by way of example, and not by way of limitation, in the figures of the corresponding drawings and in which like reference numerals refer to similar elements and in which:

[0022] FIG. 1 is an exemplary of a communications system which employs LDPC codes.

[0023] FIG. 2 illustrates an exemplary of a satellite video communications system employing LDPC codes, according to an embodiment of the invention.

[0024] FIG. 3 illustrates an exemplary of a transmitter in FIG. 1.

[0025] FIG. 4 illustrates an exemplary of a receiver in FIG. 1.

[0026] FIG. 5 is a parity check matrix representation of an exemplary irregular LDPC code of codeword length six.

[0027] FIG. 6 illustrates a bipartite graph representation of the irregular LDPC code illustrated in FIG. 5.

[0028] FIG. 7 illustrates an exemplary FER performance curve containing waterfall and error floor regions of an irregular LDPC code.

[0029] FIG. 8 illustrates the FER performance curves of the irregular LDPC codes in the invention.

[0030] FIG. 9 illustrates an exemplary block diagram of a video broadcasting transmitter showing a framing and LDPC encoding process transforming original user data into modulated frames, according to an embodiment of the invention.

[0031] FIG. 10 illustrates an exemplary formed frame structure, according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0032] The main purpose of ECC design is to construct LDPC codes with a good threshold to reduce transmission power consumption and to lower the error floor to provide satisfactory services. The main factors affecting threshold and error floor of irregular LDPC codes are check/bit distributions and Tanner graph structures. Steps involved in search-

ing for optimal check/bit degree distributions of irregular LDPC codes will first be described. Next approaches of constructing preferable Tanner graphs based on given check/bit distributions will be discussed.

[0033] Given a code rate, irregular LDPC codes with different check/bit degree distributions have a different threshold. Good check/bit degree distributions can be searched through various optimization algorithms combined with density evolution. It has been shown that density evolution is an efficient theoretical tool to track the process of iterative message-passing decoding for LDPC codes. The idea of density evolution can be traced back to Gallager's results. To determine the performance of BF decoding, Gallager derived formulas to calculate the output bit error rate (BER) for each iteration as a function of the input BER at the beginning of the iteration, and then iteratively calculated the BER at a given iteration. For a continuous alphabet, the calculation is more complex. The probability density functions (pdf) of the belief messages exchanged between bit and check nodes need to be calculated from one iteration to another, and the average BER for each iteration can be derived based on these pdf. In both check node processing and bit node processing, each outgoing belief message is a function of incoming belief messages. For a check node of degree d_c, each outgoing message U can be expressed by a function of d_c -1 incoming messages,

$$U = F_c(V_1, V_2, \ldots, V_{d_c-1}),$$

where F_c denotes the check node processing function which is determined from BP decoding. Similarly, for bit node of degree d_v, each outgoing message V can be expressed by a function of d_v -1 incoming messages and the channel belief message U_{ch},

$$V = F_V(U_{ch}, U_1, U_2, \ldots, U_{d_v-1}),$$

where F_V denotes the bit node processing function. Although for both check and bit node processing, we can derive the pdf of an outgoing message based on the pdf of incoming messages for a given decoding algorithm, there may exist an exponentially large number of possible formats of incoming messages. Therefore, the process of density evolution seems intractable. Fortunately, it has been proved in that for a given message-passing algorithm and noisy channel, if some symmetry conditions are satisfied, then the decoding BER is independent of the transmitted sequence x. That is to say, with the symmetry assumptions, the decoding BER of all-zero transmitted sequence $x = 1$ is equal to that of any randomly chosen sequence. Thus, the derivation of density evolution can be considerably simplified. The symmetry conditions required by efficient density evolution are channel symmetry, check node symmetry, and bit node symmetry. Another assumption for the density evolution is that the Tanner graph is cyclic free. In that case, the incoming messages to any bit and check node are independent, and thus the derivation for the pdf of the outgoing messages can be considerably simplified. For many LDPC codes with practical interests, the corresponding Tanner graph contains cycles. Suppose the minimum length of a cycle (or girth) in a Tanner graph of an LDPC code is equal to $4 \times l$, then the independence assumption does not hold after the l-th decoding iteration with the standard BP decoding. However, for a given iteration number, as the code length increases, the independence condition is satisfied for an increasing iteration number. Therefore, the density evolution predicts the asymptotic performance of an ensemble of LDPC codes and the "asymptotic" nature is in the sense of code length.

[0034] In order to keep the search for the optimal check/bit degree distributions of LDPC codes tractable, we let the number of types of bit nodes be four (except for rate 9/10 code which only has three types of bit nodes). For the purpose of constructing efficiently encodable irregular LDPC codes with good threshold, we let the number of bit nodes with degree two be $(N_s - K_s - 1) \times S$, where $S = 32$ is a constant, and $N_s = N / S$, $K_s = K / S$. For each code rate R, the message length can be calculated as $K = N \times R$, where $N = 15360$. Let $d_{v,x} \times S$ be the number of bit nodes with degree x. Given each R, for $d_{v,3} = 1, \ldots, K_s + 1$ and $d_{v,4} = 0, \ldots, K_s$, we can determine the number of the bit node with largest weight $d_{v,\max} = K_s + 1 - d_{v,3} - d_{v,4}$. Then we can search for the optimal check/bit degree distributions with the smallest threshold for each $d_{v,3}$. Finally among the check/bit degree distributions associated with LDPC codes having an error floor lower than 10^{-7} and codeword length $N = 15360$, we select the one with the smallest threshold. Table 1 lists the check/bit degree distributions for irregular LDPC codes with code rate ¼, 2/5, ½, 3/5, 2/3, ¾, 4/5, 5/6, 13/15, and 9/10.

Table 1 Bit node degree distributions

bit / rate	2	3	4	6	7	10	12
1/4	11264	256		3840			
2/5	8960	256	4608				1536
1/2	7424	2304	3840				1792
3/5	5888	3328	4352				1792
2/3	4864	4096	4864				1536
3/4	3584	4608	5888				1280
4/5	2816	5888	5376				1280
5/6	2304	4608	6912			1536	
13/15	1792	5632	6912		1024		
9/10	1280	3584	10496				

[0035] Given the check/bit degree distributions, an LDPC code can be constructed in several methods. These methods can be decomposed into two main classes, random or pseudorandom constructions, and algebraic constructions. Since the special structure of algebraic LDPC codes greatly facilitate the hardware implementation of decoders, we consider algebraic constructions. Algebraic constructions of LDPC codes can be further decomposed into two main categories. The first category is based on finite geometries while the second category is based on cyclic-shift matrices. Because of the flexible parameters of cyclic-shift-based LDPC codes, we consider LDPC codes constructed based on circulant permutation matrices. The parity check matrix of a quasi-cyclic LDPC code is expanded from a base matrix associated with shift numbers. Given check/bit degree distributions, the ultimate performance of an LDPC code decoded by the BP algorithm mainly depends on the smallest length of loops in the corresponding Tanner graph, which is called girth. The girth of a quasi-cyclic LDPC codes is determined by the girth of the Tanner graph of the based matrix and the shift numbers. Conventionally, the Tanner graph of the base matrix first optimized based on the check/bit degree distributions, then optimal shift values are assigned to entries of the base matrix. According to a method of the invention for constructing quasi-cyclic LDPC codes, the Tanner graph of the base matrix and the shift values are optimized simultaneously.

[0036] It should be understood that the following specification may be performed or stored on a computer-readable storage media, computer software, or hardware, such as storage tapes, RAM, ROM, flash memory, synthesized logic as is well known in the art.

[0037] In the invention, each LDPC code is defined by a binary parity check matrix **H** of size $(N - K) \times N$, which is expanded from a base matrix B of size $\left(\frac{N-K}{32}\right) \times \left(\frac{N}{32}\right)$. The base matrix defining (through expanded to parity check matrix) each LDPC code in the invention is specified by the specification in the appendix. Each specification of the base matrix contains groups of numbers and each group contains 3 numbers. Each group of 3 numbers *i j k* specifies a non-negative entry of base matrix **B, i. e,** $B_{i,j} = k$. For instance, Table A of the Appendix is the specification of $\mathbf{B}_{\frac{1}{4}}$ which defines the base matrix **B** for the rate-1/4 LDPC code and the first group 0 61 9 denotes $B_{0,61} = 9$. All the entries not specified in the corresponding table are assigned with value -1. The parity check matrix **H** is expanded from **B** by replacing each non-negative entry $B_{i,j}$ with a $B_{i,j}$ -right-shifted identity matrix of size 32×32 , and each negative entry with an all-zero matrix of size 32×32. A $B_{i,j}$ -right-shifted identity matrix is a circulant permutation matrix with a 1 at column- $(r + B_{i,j})$ mod 32 for row- r , $0 \le r \le 31$, and zero elsewhere. All the LDPC codes in the invention have codeword

length 15360, therefore the parity check matrix **H** of the LDPC code with rate *R* contains 15360 × (1- *R*) rows and 15360 columns.

[0038] LDPC codes in the invention are linear block codes. Once the parity check matrix *H* of size (*N* - *K*) × *N* is specified, an LDPC code with codeword length *N* and dimension *K* is uniquely defined by *H.* Exchanging among any rows of parity check matrix *H* results in a new parity check matrix *H',* which is called permutation of *H.* The LDPC code defined by a parity check matrix *H* is the same LDPC code defined by the permutation of the parity check matrix *H.* Therefore, when we refer to an LDPC code defined by a parity check matrix *H* , we refer to an equivalent LDPC code defined by any possible permutation of *H.* Besides permutation of parity check matrix H , there exist many other ways to define or describe the LDPC code defined by *H.* When we refer to an LDPC code defined by a parity check matrix *H*, we refer to an equivalent LDPC code described in any format.

[0039] FIG. 1 is a diagram of a communications system employing LDPC codes, according to an embodiment of the invention. A communications system includes a transmitter 101 which generates signal waveforms across a communication channel 102 to a receiver 103. The transmitter 101 contains a message source producing a discrete set of possible messages and each of these messages corresponds a signal waveform. The waveforms enter the channel 102 and is corrupted by noise. LDPC codes are employed to reduce the disturbances introduced by the channel 102.

[0040] FIG. 2 depicts a diagram of a video broadcasting system using LDPC codes, according to an embodiment of the inversion. The satellite 201 broadcasts video program from the hub station 202 to the satellite terminals 203, which may include a set top box 204 for interfacing with a television display 205. In direct video broadcasting applications, power and bandwidth efficiency are essential. In the conventional video broadcasting systems, ECC techniques such as turbo trellis coding are used to provide power and bandwidth efficiency. Nevertheless, the conventional ECC techniques require higher complexity and offer low throughput given power constraint. In contrast, LDPC codes can offer high power and bandwidth efficiency without increased complexity. What is more, the structures of LDPC codes make them essentially suitable for parallel decoding which can greatly reduce decoding delay.

[0041] FIG. 3 depicts an exemplary transmitter 101; 300 in the communications system of FIG. 1 which employs LDPC codes as ECC. The LDPC encoder 302 encodes information bits from source 301 into LDPC codewords. The mapping from each information block to each LDPC codeword is specified by the parity check matrix (or equivalently the generator matrix) of the LDPC code. The LDPC codeword is interleaved (for some communication systems) and modulated to signal waveforms by the interleaver/modulator 303. These signal waveforms are sent to a transmit antenna 304 and propagated to a receiver shown in FIG. 4.

[0042] FIG. 4 depicts an exemplary receiver 103; 400 in FIG. 1 which employs LDPC codes as ECC. Signal waveforms are received by the receiving antenna 401 and distributed to demodulator/deinterleaveror 402. Signal waveforms are demodulated by demodulator and deinterleaved by deinterleavor (for some communication systems) and then distributed to a LDPC decoder 403 which iteratively decodes the received messages and output estimations of the transmitted codeword.

[0043] For most video broadcasting systems, directly transmitting an LDPC encoded and modulated signal waveforms is not acceptable, because receivers can't decode received signals without knowing where each encoded LDPC codeword starts or ends. Time references (or markers) therefore have been necessary throughout the transmission to help identify the positions of LDPC codewords. Similarly, typical communication systems require that receiver's time and frequency be locked to a transmitter's reference, which is referred to as synchronization.

[0044] Furthermore, certain overhead information is typically periodically transferred to enable receivers to properly demodulate transmitted signals, decode signals and abstract user messages. For at least these reasons, typical transmitters insert a synchronization pattern and a header periodically into encoded messages, a process called frame formatting. Typically, a receiver first tries to lock onto a synchronization pattern and then decodes the header and message signal. Frame formatting design is critical to overall system performance and can directly impact the cost of establishing and operating a communication system. Frame formatting design often depends on many factors, such as channel characteristics, modulation type and ECC scheme. A well-designed frame format may result in high performance receivers that achieve fast frame acquisition, reliable tracking (time and frequency lock) and improved ECC decoding performance (such as meeting the required FER) with minimum overhead at a low cost.

[0045] FIG. 8 depicts the performance of the family of quasi-cyclic irregular LDPC codes of code rate ½, 3/5, 2/3, ¾, 4/5, 5/6, 13/15, and 9/10. From the simulation results, we observe that all codes have error floor lower than 10^{-7} and exhibit good threshold.

[0046] FIG. 9 illustrates an exemplary block diagram of a video broadcasting transmitter showing a framing and LDPC encoding process transforming original user data into modulated frames, according to an embodiment of the invention. Through a process of frame grouping 901, the input data bits to be transmitted are first divided into subsequent groups, e. g. group n and group n+1. Each group contains a number of information bits required for the corresponding frame. Each of the information groups is then prefixed by a header (H) by the header insertion module 902. The header, along with each group, is further divided into j (an integer) sub-groups (sg) by the codeword grouping module 903, with each sub-group carrying an equal number of bits. For illustration purpose, j denotes the number of sub-groups in each group.

For each sub-group, in an LDPC encoding 904 process, an LDPC encoder computes the error checking and error correction parity bits (P) of a fixed length based on the sub-group's data pattern and attaches the parity bits to the end of the associated sub-group to form a code word. Then the symbol mapping module 905 maps the bit stream of each codeword into modulation symbols according to the corresponding modulation type in the codeword. Following the symbol mapping, all frames are of an equal length, regardless of modulation used. Next the pilot insertion module 906 may insert a number of pilot waves (p) evenly into the encoded frames as shown in FIG. 1. Also, the UW and ACC insertion module 907 will add a UW followed by an ACC at the beginning of each frame. The symbol scrambler 908 scrambles the symbols of each frame except the UW using a fixed scrambling pattern. Finally, all the symbols may be modulated by modulator 909 to a radio frequency for transmission through an antenna.

[0047] FIG. 10 depicts an exemplary frame format of a transmitted frame containing encoded LDPC codewords according to an embodiment of the invention. The frame starts with an 64-symbol unique word 1001, followed by 64-symbol auxiliary control code 1002, and m+1 segments 1003 of encoded LDPC data (or payload data) separated by m evenly distributed pilots 1004.

[0048] Appendix Tables A-J are specifications of the base matrices B for the code rates of ¼, 2/5, 1/2, 3/5, 2/3, ¾, 4/5, 5/6, 13/15, and 9/10, respectively.

[0049] Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art, that any arrangement which is calculated to achieve the same purpose may be substituted for the specific embodiments shown. It is to be understood, that the above description is intended to be illustrative and not restrictive. This application is intended to cover any adaptations or variations of the invention. Combinations of the above embodiments and many other embodiments will be apparent to those of skill in the art upon reading and understanding the above description. The scope of the invention includes any other embodiments and applications in which the above structures and methods may be used. The scope of the invention should, therefore, be determined with reference to the appended claims along with the full scope of equivalents to which such claims are entitled.

APPENDIX

Appendix Table A: Specification of the base matrix $B_{\frac{1}{4}}$ for the rate-1/4 LDPC code

0	61	9	0	119	21	0	120	0	0	128	0	1	47	0	1	103	6
1	165	0	1	173	0	2	30	1	2	113	0	2	210	0	2	218	0
3	23	21	3	86	17	3	255	0	3	263	0	4	0	7	4	60	5
4	125	0	4	300	0	4	308	0	5	38	3	5	70	20	5	345	0
5	353	0	6	9	2	6	76	7	6	390	0	6	398	0	7	7	18
7	108	14	7	435	0	7	443	0	8	62	9	8	112	22	8	121	0
8	129	0	9	40	1	9	96	7	9	166	0	9	174	0	10	31	1
10	114	0	10	211	0	10	219	0	11	5	31	11	30	30	11	119	22
11	256	0	11	264	0	12	1	7	12	61	5	12	126	0	12	301	0
12	309	0	13	39	3	13	71	20	13	346	0	13	354	0	14	10	2
14	77	7	14	391	0	14	399	0	15	0	19	15	109	14	15	436	0
15	444	0	16	63	9	16	113	22	16	122	0	16	130	0	17	41	1
17	97	7	17	167	0	17	175	0	18	24	2	18	115	0	18	212	0
18	220	0	19	6	31	19	31	30	19	112	23	19	257	0	19	265	0
20	2	7	20	62	5	20	127	0	20	302	0	20	310	0	21	32	4
21	64	21	21	347	0	21	355	0	22	4	1	22	114	7	22	392	0
22	400	0	23	1	19	23	110	14	23	437	0	23	445	0	24	56	10
24	114	22	24	123	0	24	131	0	25	37	16	25	94	31	25	168	0
25	176	0	26	25	2	26	116	0	26	213	0	26	221	0	27	7	31
27	24	31	27	113	23	27	258	0	27	266	0	28	3	7	28	63	5
28	120	1	28	303	0	28	311	0	29	33	4	29	65	21	29	348	0
29	356	0	30	5	1	30	115	7	30	393	0	30	401	0	31	2	19
31	111	14	31	438	0	31	446	0	32	57	10	32	115	22	32	124	0
32	132	0	33	38	16	33	95	31	33	169	0	33	177	0	34	26	2
34	117	0	34	214	0	34	222	0	35	0	0	35	25	31	35	114	23
35	259	0	35	267	0	36	45	2	36	85	30	36	304	0	36	312	0
37	34	4	37	66	21	37	349	0	37	357	0	38	6	1	38	116	7
38	394	0	38	402	0	39	3	19	39	104	15	39	439	0	39	447	0
40	58	10	40	116	22	40	125	0	40	133	0	41	39	16	41	88	0
41	170	0	41	178	0	42	27	2	42	118	0	42	215	0	42	223	0
43	1	0	43	26	31	43	115	23	43	260	0	43	268	0	44	46	2
44	86	30	44	305	0	44	313	0	45	35	4	45	67	21	45	350	0
45	358	0	46	7	1	46	117	7	46	395	0	46	403	0	47	28	16
47	106	31	47	440	0	47	448	0	48	59	10	48	117	22	48	126	0
48	134	0	49	32	17	49	89	0	49	171	0	49	179	0	50	21	23
50	76	25	50	216	0	50	224	0	51	2	0	51	27	31	51	116	23
51	261	0	51	269	0	52	47	2	52	87	30	52	306	0	52	314	0
53	36	4	53	68	21	53	351	0	53	359	0	54	0	2	54	118	7
54	396	0	54	404	0	55	29	16	55	107	31	55	441	0	55	449	0
56	60	10	56	118	22	56	127	0	56	135	0	57	33	17	57	90	0
57	172	0	57	180	0	58	22	23	58	77	25	58	217	0	58	225	0
59	3	0	59	28	31	59	117	23	59	262	0	59	270	0	60	40	3
60	80	31	60	307	0	60	315	0	61	30	22	61	112	4	61	352	0
61	360	0	62	1	2	62	119	7	62	397	0	62	405	0	63	30	16
63	108	31	63	442	0	63	450	0	64	59	2	64	111	21	64	128	0
64	136	0	65	34	17	65	91	0	65	173	0	65	181	0	66	23	23
66	78	25	66	218	0	66	226	0	67	4	0	67	29	31	67	118	23

67	263	0	67	271	0	68	41	3	68	81	31	68	308	0	68	316	0
69	31	22	69	113	4	69	353	0	69	361	0	70	2	2	70	112	8
70	398	0	70	406	0	71	31	16	71	109	31	71	443	0	71	451	0
72	60	2	72	104	22	72	129	0	72	137	0	73	35	17	73	92	0
73	174	0	73	182	0	74	16	24	74	79	25	74	219	0	74	227	0
75	33	4	75	64	6	75	264	0	75	272	0	76	42	3	76	82	31
76	309	0	76	317	0	77	24	23	77	114	4	77	354	0	77	362	0
78	3	2	78	113	8	78	399	0	78	407	0	79	24	17	79	110	31
79	444	0	79	452	0	80	61	2	80	105	22	80	130	0	80	138	0
81	36	17	81	93	0	81	175	0	81	183	0	82	17	24	82	72	26
82	220	0	82	228	0	83	34	4	83	65	6	83	265	0	83	273	0
84	43	3	84	83	31	84	310	0	84	318	0	85	25	23	85	115	4
85	355	0	85	363	0	86	19	3	86	61	4	86	400	0	86	408	0
87	25	17	87	111	31	87	445	0	87	453	0	88	62	2	88	106	22
88	131	0	88	139	0	89	40	15	89	114	11	89	176	0	89	184	0
90	18	24	90	73	26	90	221	0	90	229	0	91	35	4	91	66	6
91	266	0	91	274	0	92	44	3	92	84	31	92	311	0	92	319	0
93	26	23	93	116	4	93	356	0	93	364	0	94	20	3	94	62	4
94	401	0	94	409	0	95	26	17	95	104	0	95	446	0	95	454	0
96	63	2	96	107	22	96	132	0	96	140	0	97	41	15	97	115	11
97	177	0	97	185	0	98	19	24	98	74	26	98	222	0	98	230	0
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102	21	3	102	63	4	102	402	0	102	410	0	103	27	17	103	105	0
103	447	0	103	455	0	104	56	3	104	108	22	104	133	0	104	141	0
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106	223	0	106	231	0	107	37	4	107	68	6	107	268	0	107	276	0
108	10	11	108	66	2	108	313	0	108	321	0	109	28	23	109	118	4
109	358	0	109	366	0	110	22	3	110	56	5	110	403	0	110	411	0
111	72	5	111	448	0	111	456	0	112	57	3	112	109	22	112	134	0
112	142	0	113	43	15	113	117	11	113	179	0	113	187	0	114	49	1
114	96	24	114	224	0	114	232	0	115	38	4	115	69	6	115	269	0
115	277	0	116	11	11	116	67	2	116	314	0	116	322	0	117	29	23
117	119	4	117	359	0	117	367	0	118	23	3	118	57	5	118	404	0
118	412	0	119	73	5	119	449	0	119	457	0	120	58	3	120	110	22
120	135	0	120	143	0	121	44	15	121	118	11	121	180	0	121	188	0
122	50	1	122	97	24	122	225	0	122	233	0	123	39	4	123	70	6
123	270	0	123	278	0	124	12	11	124	68	2	124	315	0	124	323	0
125	39	25	125	64	16	125	360	0	125	368	0	126	16	4	126	58	5
126	405	0	126	413	0	127	74	5	127	450	0	127	458	0	128	58	8
128	108	7	128	136	0	128	144	0	129	45	15	129	119	11	129	181	0
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131	71	6	131	271	0	131	279	0	132	13	11	132	69	2	132	316	0
132	324	0	133	32	26	133	65	16	133	361	0	133	369	0	134	17	4
134	59	5	134	406	0	134	414	0	135	75	5	135	451	0	135	459	0
136	59	8	136	109	7	136	137	0	136	145	0	137	46	15	137	112	12
137	182	0	137	190	0	138	52	1	138	99	24	138	227	0	138	235	0
139	36	20	139	95	14	139	272	0	139	280	0	140	14	11	140	70	2
140	317	0	140	325	0	141	33	26	141	66	16	141	362	0	141	370	0
142	18	4	142	60	5	142	407	0	142	415	0	143	76	5	143	452	0
143	460	0	144	60	8	144	110	7	144	138	0	144	146	0	145	47	15
145	113	12	145	183	0	145	191	0	146	53	1	146	100	24	146	228	0
146	236	0	147	37	20	147	88	15	147	273	0	147	281	0	148	15	11

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151	453	0	151	461	0	152	61	8	152	111	7	152	139	0	152	147	0
153	45	14	153	82	31	153	184	0	153	192	0	154	54	1	154	101	24
154	229	0	154	237	0	155	38	20	155	89	15	155	274	0	155	282	0
156	8	12	156	64	3	156	319	0	156	327	0	157	35	26	157	68	16
157	364	0	157	372	0	158	16	0	158	91	4	158	409	0	158	417	0
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160	148	0	161	46	14	161	83	31	161	185	0	161	193	0	162	55	1
162	102	24	162	230	0	162	238	0	163	39	20	163	90	15	163	275	0
163	283	0	164	21	23	164	97	25	164	320	0	164	328	0	165	36	26
165	69	16	165	365	0	165	373	0	166	17	0	166	92	4	166	410	0
166	418	0	167	79	5	167	455	0	167	463	0	168	63	8	168	105	8
168	141	0	168	149	0	169	47	14	169	84	31	169	186	0	169	194	0
170	48	2	170	103	24	170	231	0	170	239	0	171	32	21	171	91	15
171	276	0	171	284	0	172	22	23	172	98	25	172	321	0	172	329	0
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174	411	0	174	419	0	175	19	15	175	87	24	175	456	0	175	464	0
176	56	9	176	106	8	176	142	0	176	150	0	177	40	15	177	85	31
177	187	0	177	195	0	178	26	5	178	99	7	178	232	0	178	240	0
179	33	21	179	92	15	179	277	0	179	285	0	180	23	23	180	99	25
180	322	0	180	330	0	181	38	26	181	71	16	181	367	0	181	375	0
182	19	0	182	94	4	182	412	0	182	420	0	183	20	15	183	80	25
183	457	0	183	465	0	184	57	9	184	107	8	184	143	0	184	151	0
185	41	15	185	86	31	185	188	0	185	196	0	186	27	5	186	100	7
186	233	0	186	241	0	187	34	21	187	93	15	187	278	0	187	286	0
188	16	24	188	100	25	188	323	0	188	331	0	189	47	22	189	96	18
189	368	0	189	376	0	190	20	0	190	95	4	190	413	0	190	421	0
191	21	15	191	81	25	191	458	0	191	466	0	192	52	22	192	107	22
192	144	0	192	152	0	193	42	15	193	87	31	193	189	0	193	197	0
194	28	5	194	101	7	194	234	0	194	242	0	195	35	21	195	94	15
195	279	0	195	287	0	196	17	24	196	101	25	196	324	0	196	332	0
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198	414	0	198	422	0	199	22	15	199	82	25	199	459	0	199	467	0
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206	22	0	206	89	5	206	415	0	206	423	0	207	23	15	207	83	25
207	460	0	207	468	0	208	54	22	208	109	22	208	146	0	208	154	0
209	44	15	209	81	0	209	191	0	209	199	0	210	30	5	210	103	7
210	236	0	210	244	0	211	32	24	211	95	23	211	281	0	211	289	0
212	19	24	212	103	25	212	326	0	212	334	0	213	42	23	213	99	18
213	371	0	213	379	0	214	15	19	214	69	26	214	416	0	214	424	0
215	16	16	215	84	25	215	461	0	215	469	0	216	55	22	216	110	22
216	147	0	216	155	0	217	53	23	217	90	18	217	192	0	217	200	0
218	31	5	218	96	8	218	237	0	218	245	0	219	33	24	219	88	24
219	282	0	219	290	0	220	20	24	220	96	26	220	327	0	220	335	0
221	43	23	221	100	18	221	372	0	221	380	0	222	8	20	222	70	26
222	417	0	222	425	0	223	17	16	223	85	25	223	462	0	223	470	0
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225	193	0	225	201	0	226	24	6	226	97	8	226	238	0	226	246	0
227	34	24	227	89	24	227	283	0	227	291	0	228	3	0	228	96	13

228	328	0	228	336	0	229	44	23	229	101	18	229	373	0	229	381	0
230	9	20	230	71	26	230	418	0	230	426	0	231	18	16	231	86	25
231	463	0	231	471	0	232	49	23	232	104	23	232	149	0	232	157	0
233	55	23	233	92	18	233	194	0	233	202	0	234	25	6	234	98	8
234	239	0	234	247	0	235	35	24	235	90	24	235	284	0	235	292	0
236	4	0	236	97	13	236	329	0	236	337	0	237	45	23	237	102	18
237	374	0	237	382	0	238	10	20	238	64	27	238	419	0	238	427	0
239	15	29	239	83	20	239	464	0	239	472	0	240	50	23	240	105	23
240	150	0	240	158	0	241	48	24	241	93	18	241	195	0	241	203	0
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243	285	0	243	293	0	244	5	0	244	98	13	244	330	0	244	338	0
245	46	23	245	103	18	245	375	0	245	383	0	246	11	20	246	65	27
246	420	0	246	428	0	247	8	30	247	84	20	247	465	0	247	473	0
248	51	23	248	106	23	248	151	0	248	159	0	249	49	24	249	94	18
249	196	0	249	204	0	250	14	16	250	74	24	250	241	0	250	249	0
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252	331	0	252	339	0	253	41	23	253	80	16	253	376	0	253	384	0
254	12	20	254	66	27	254	421	0	254	429	0	255	9	30	255	85	20
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257	50	24	257	95	18	257	197	0	257	205	0	258	15	16	258	75	24
258	242	0	258	250	0	259	38	24	259	93	24	259	287	0	259	295	0
260	7	0	260	100	13	260	332	0	260	340	0	261	42	23	261	81	16
261	377	0	261	385	0	262	13	20	262	67	27	262	422	0	262	430	0
263	10	30	263	86	20	263	467	0	263	475	0	264	55	20	264	107	9
264	153	0	264	161	0	265	51	24	265	88	19	265	198	0	265	206	0
266	8	17	266	76	24	266	243	0	266	251	0	267	8	0	267	64	0
267	288	0	267	296	0	268	0	1	268	101	13	268	333	0	268	341	0
269	43	23	269	82	16	269	378	0	269	386	0	270	14	20	270	68	27
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273	199	0	273	207	0	274	9	17	274	77	24	274	244	0	274	252	0
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276	334	0	276	342	0	277	44	23	277	83	16	277	379	0	277	387	0
278	54	6	278	75	21	278	424	0	278	432	0	279	12	30	279	80	21
279	469	0	279	477	0	280	49	21	280	109	9	280	155	0	280	163	0
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282	245	0	282	253	0	283	10	0	283	66	0	283	290	0	283	298	0
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285	380	0	285	388	0	286	55	6	286	76	21	286	425	0	286	433	0
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294	426	0	294	434	0	295	14	30	295	82	21	295	471	0	295	479	0
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297	202	0	297	210	0	298	12	17	298	72	25	298	247	0	298	255	0
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318	429	0	318	437	0	319	1	5	319	62	26	319	124	0	319	474	0
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321	205	0	321	213	0	322	18	21	322	81	17	322	250	0	322	258	0
323	15	0	323	71	0	323	295	0	323	303	0	324	48	15	324	73	8
324	340	0	324	348	0	325	12	1	325	79	6	325	385	0	325	393	0
326	52	7	326	73	22	326	430	0	326	438	0	327	2	5	327	63	26
327	125	0	327	475	0	328	43	0	328	99	6	328	161	0	328	169	0
329	27	22	329	94	29	329	206	0	329	214	0	330	19	21	330	82	17
330	251	0	330	259	0	331	4	6	331	56	5	331	121	0	331	296	0
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333	72	7	333	386	0	333	394	0	334	53	7	334	74	22	334	431	0
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336	100	6	336	162	0	336	170	0	337	28	22	337	95	29	337	207	0
337	215	0	338	20	21	338	83	17	338	252	0	338	260	0	339	5	6
339	57	5	339	122	0	339	297	0	339	305	0	340	50	15	340	75	8
340	342	0	340	350	0	341	14	1	341	73	7	341	387	0	341	395	0
342	4	18	342	105	14	342	432	0	342	440	0	343	4	5	343	57	27
343	127	0	343	477	0	344	45	0	344	101	6	344	163	0	344	171	0
345	28	1	345	119	31	345	208	0	345	216	0	346	21	21	346	84	17
346	253	0	346	261	0	347	6	6	347	58	5	347	123	0	347	298	0
347	306	0	348	51	15	348	76	8	348	343	0	348	351	0	349	15	1
349	74	7	349	388	0	349	396	0	350	5	18	350	106	14	350	433	0
350	441	0	351	5	5	351	58	27	351	120	1	351	478	0	352	46	0
352	102	6	352	164	0	352	172	0	353	29	1	353	112	0	353	209	0
353	217	0	354	22	21	354	85	17	354	254	0	354	262	0	355	7	6
355	59	5	355	124	0	355	299	0	355	307	0	356	37	3	356	69	20
356	344	0	356	352	0	357	8	2	357	75	7	357	389	0	357	397	0
358	6	18	358	107	14	358	434	0	358	442	0	359	6	5	359	59	27
359	121	1	359	479	0												

Appendix Table B: Specification the base matrix $B_{\frac{2}{5}}$ for the rate-2/5 LDPC code

0	18	12	0	42	1	0	113	18	0	184	9	0	192	0	0	200	0
1	12	23	1	37	20	1	97	29	1	175	13	1	228	0	1	236	0
2	10	6	2	39	3	2	96	6	2	149	18	2	264	0	2	272	0
3	12	11	3	40	3	3	72	28	3	182	8	3	300	0	3	308	0
4	19	29	4	45	18	4	87	20	4	193	0	4	336	0	4	344	0
5	19	16	5	28	26	5	61	11	5	186	14	5	372	0	5	380	0
6	7	13	6	47	0	6	58	11	6	191	16	6	408	0	6	416	0
7	22	20	7	52	27	7	108	23	7	170	24	7	444	0	7	452	0
8	19	12	8	43	1	8	114	18	8	185	9	8	193	0	8	201	0
9	13	23	9	38	20	9	98	29	9	168	14	9	229	0	9	237	0
10	11	6	10	32	4	10	97	6	10	150	18	10	265	0	10	273	0
11	13	11	11	41	3	11	73	28	11	183	8	11	301	0	11	309	0
12	20	29	12	46	18	12	80	21	12	194	0	12	337	0	12	345	0
13	20	16	13	29	26	13	62	11	13	187	14	13	373	0	13	381	0
14	0	14	14	40	1	14	59	11	14	184	17	14	409	0	14	417	0
15	23	20	15	53	27	15	109	23	15	171	24	15	445	0	15	453	0
16	20	12	16	44	1	16	115	18	16	186	9	16	194	0	16	202	0
17	14	23	17	39	20	17	99	29	17	169	14	17	230	0	17	238	0
18	12	6	18	33	4	18	98	6	18	151	18	18	266	0	18	274	0
19	14	11	19	42	3	19	74	28	19	176	9	19	302	0	19	310	0
20	21	29	20	47	18	20	81	21	20	195	0	20	338	0	20	346	0
21	21	16	21	30	26	21	63	11	21	188	14	21	374	0	21	382	0
22	1	14	22	41	1	22	60	11	22	185	17	22	410	0	22	418	0
23	16	21	23	54	27	23	110	23	23	172	24	23	446	0	23	454	0
24	21	12	24	45	1	24	116	18	24	187	9	24	195	0	24	203	0
25	15	23	25	32	21	25	100	29	25	170	14	25	231	0	25	239	0
26	13	6	26	34	4	26	99	6	26	144	19	26	267	0	26	275	0
27	15	11	27	43	3	27	75	28	27	177	9	27	303	0	27	311	0
28	22	29	28	40	19	28	82	21	28	196	0	28	339	0	28	347	0
29	22	16	29	31	26	29	56	12	29	189	14	29	375	0	29	383	0
30	2	14	30	42	1	30	61	11	30	186	17	30	411	0	30	419	0
31	17	21	31	55	27	31	111	23	31	173	24	31	447	0	31	455	0
32	22	12	32	46	1	32	117	18	32	188	9	32	196	0	32	204	0
33	5	14	33	27	4	33	119	11	33	162	29	33	232	0	33	240	0
34	14	6	34	35	4	34	100	6	34	145	19	34	268	0	34	276	0
35	6	20	35	24	0	35	115	1	35	138	29	35	304	0	35	312	0
36	23	29	36	41	19	36	83	21	36	197	0	36	340	0	36	348	0
37	12	24	37	37	23	37	99	26	37	134	26	37	376	0	37	384	0
38	3	14	38	43	1	38	62	11	38	187	17	38	412	0	38	420	0
39	8	29	39	24	1	39	66	10	39	128	25	39	448	0	39	456	0
40	23	12	40	47	1	40	118	18	40	189	9	40	197	0	40	205	0
41	6	14	41	28	4	41	112	12	41	163	29	41	233	0	41	241	0
42	15	6	42	36	4	42	101	6	42	146	19	42	269	0	42	277	0
43	7	20	43	25	0	43	116	1	43	139	29	43	305	0	43	313	0
44	16	30	44	42	19	44	84	21	44	198	0	44	341	0	44	349	0
45	13	24	45	38	23	45	100	26	45	135	26	45	377	0	45	385	0
46	4	14	46	44	1	46	63	11	46	188	17	46	413	0	46	421	0
47	9	29	47	25	1	47	67	10	47	129	25	47	449	0	47	457	0
48	16	13	48	40	2	48	119	18	48	190	9	48	198	0	48	206	0
49	7	14	49	29	4	49	113	12	49	164	29	49	234	0	49	242	0

50	8	7	50	37	4	50	102	6	50	147	19	50	270	0	50	278	0
51	0	21	51	26	0	51	117	1	51	140	29	51	306	0	51	314	0
52	17	30	52	43	19	52	85	21	52	199	0	52	342	0	52	350	0
53	14	24	53	39	23	53	101	26	53	128	27	53	378	0	53	386	0
54	5	14	54	45	1	54	56	12	54	189	17	54	414	0	54	422	0
55	10	29	55	26	1	55	68	10	55	130	25	55	450	0	55	458	0
56	17	13	56	41	2	56	112	19	56	191	9	56	199	0	56	207	0
57	0	15	57	30	4	57	114	12	57	165	29	57	235	0	57	243	0
58	9	7	58	38	4	58	103	6	58	148	19	58	271	0	58	279	0
59	1	21	59	27	0	59	118	1	59	141	29	59	307	0	59	315	0
60	18	30	60	44	19	60	86	21	60	192	1	60	343	0	60	351	0
61	15	24	61	32	24	61	102	26	61	129	27	61	379	0	61	387	0
62	6	14	62	46	1	62	57	12	62	190	17	62	415	0	62	423	0
63	11	29	63	27	1	63	69	10	63	131	25	63	451	0	63	459	0
64	17	1	64	36	28	64	107	31	64	178	9	64	200	0	64	208	0
65	1	15	65	31	4	65	115	12	65	166	29	65	236	0	65	244	0
66	23	16	66	36	14	66	82	9	66	148	20	66	272	0	66	280	0
67	2	21	67	28	0	67	119	1	67	142	29	67	308	0	67	316	0
68	11	15	68	27	1	68	71	7	68	154	8	68	344	0	68	352	0
69	8	25	69	33	24	69	103	26	69	130	27	69	380	0	69	388	0
70	5	15	70	42	18	70	113	7	70	141	30	70	416	0	70	424	0
71	12	29	71	28	1	71	70	10	71	132	25	71	452	0	71	460	0
72	18	1	72	37	28	72	108	31	72	179	9	72	201	0	72	209	0
73	2	15	73	24	5	73	116	12	73	167	29	73	237	0	73	245	0
74	16	17	74	37	14	74	83	9	74	149	20	74	273	0	74	281	0
75	3	21	75	29	0	75	112	2	75	143	29	75	309	0	75	317	0
76	12	15	76	28	1	76	64	8	76	155	8	76	345	0	76	353	0
77	9	25	77	34	24	77	96	27	77	131	27	77	381	0	77	389	0
78	6	15	78	43	18	78	114	7	78	142	30	78	417	0	78	425	0
79	13	29	79	29	1	79	71	10	79	133	25	79	453	0	79	461	0
80	19	1	80	38	28	80	109	31	80	180	9	80	202	0	80	210	0
81	3	15	81	25	5	81	117	12	81	160	30	81	238	0	81	246	0
82	17	17	82	38	14	82	84	9	82	150	20	82	274	0	82	282	0
83	4	21	83	30	0	83	113	2	83	136	30	83	310	0	83	318	0
84	13	15	84	29	1	84	65	8	84	156	8	84	346	0	84	354	0
85	10	25	85	35	24	85	97	27	85	132	27	85	382	0	85	390	0
86	7	15	86	44	18	86	115	7	86	143	30	86	418	0	86	426	0
87	14	29	87	30	1	87	64	11	87	134	25	87	454	0	87	462	0
88	20	1	88	39	28	88	110	31	88	181	9	88	203	0	88	211	0
89	4	15	89	26	5	89	118	12	89	161	30	89	239	0	89	247	0
90	18	17	90	39	14	90	85	9	90	151	20	90	275	0	90	283	0
91	5	21	91	31	0	91	114	2	91	137	30	91	311	0	91	319	0
92	14	15	92	30	1	92	66	8	92	157	8	92	347	0	92	355	0
93	11	25	93	36	24	93	98	27	93	133	27	93	383	0	93	391	0
94	0	16	94	45	18	94	116	7	94	136	31	94	419	0	94	427	0
95	15	29	95	31	1	95	65	11	95	135	25	95	455	0	95	463	0
96	21	1	96	32	29	96	111	31	96	182	9	96	204	0	96	212	0
97	17	11	97	30	7	97	88	14	97	187	30	97	240	0	97	248	0
98	19	17	98	32	15	98	86	9	98	144	21	98	276	0	98	284	0
99	6	0	99	28	30	99	77	26	99	142	2	99	312	0	99	320	0
100	15	15	100	31	1	100	67	8	100	158	8	100	348	0	100	356	0
101	11	19	101	25	11	101	69	4	101	160	6	101	384	0	101	392	0
102	1	16	102	46	18	102	117	7	102	137	31	102	420	0	102	428	0

103	13	2	103	35	5	103	56	17	103	170	9	103	456	0	103	464	0
104	22	1	104	33	29	104	104	0	104	183	9	104	205	0	104	213	0
105	18	11	105	31	7	105	89	14	105	188	30	105	241	0	105	249	0
106	20	17	106	33	15	106	87	9	106	145	21	106	277	0	106	285	0
107	7	0	107	29	30	107	78	26	107	143	2	107	313	0	107	321	0
108	8	16	108	24	2	108	68	8	108	159	8	108	349	0	108	357	0
109	12	19	109	26	11	109	70	4	109	161	6	109	385	0	109	393	0
110	2	16	110	47	18	110	118	7	110	138	31	110	421	0	110	429	0
111	14	2	111	36	5	111	57	17	111	171	9	111	457	0	111	465	0
112	23	1	112	34	29	112	105	0	112	176	10	112	206	0	112	214	0
113	19	11	113	24	8	113	90	14	113	189	30	113	242	0	113	250	0
114	21	17	114	34	15	114	80	10	114	146	21	114	278	0	114	286	0
115	0	1	115	30	30	115	79	26	115	136	3	115	314	0	115	322	0
116	9	16	116	25	2	116	69	8	116	152	9	116	350	0	116	358	0
117	13	19	117	27	11	117	71	4	117	162	6	117	386	0	117	394	0
118	3	16	118	40	19	118	119	7	118	139	31	118	422	0	118	430	0
119	15	2	119	37	5	119	58	17	119	172	9	119	458	0	119	466	0
120	16	2	120	35	29	120	106	0	120	177	10	120	207	0	120	215	0
121	20	11	121	25	8	121	91	14	121	190	30	121	243	0	121	251	0
122	22	17	122	35	15	122	81	10	122	147	21	122	279	0	122	287	0
123	1	1	123	31	30	123	72	27	123	137	3	123	315	0	123	323	0
124	10	16	124	26	2	124	70	8	124	153	9	124	351	0	124	359	0
125	14	19	125	28	11	125	64	5	125	163	6	125	387	0	125	395	0
126	4	16	126	41	19	126	112	8	126	140	31	126	423	0	126	431	0
127	8	3	127	38	5	127	59	17	127	173	9	127	459	0	127	467	0
128	17	21	128	34	25	128	104	13	128	177	7	128	208	0	128	216	0
129	21	11	129	26	8	129	92	14	129	191	30	129	244	0	129	252	0
130	7	1	130	34	15	130	84	0	130	145	23	130	280	0	130	288	0
131	2	1	131	24	31	131	73	27	131	138	3	131	316	0	131	324	0
132	15	8	132	47	23	132	95	19	132	156	14	132	352	0	132	360	0
133	15	19	133	29	11	133	65	5	133	164	6	133	388	0	133	396	0
134	15	13	134	26	31	134	63	15	134	151	10	134	424	0	134	432	0
135	9	3	135	39	5	135	60	17	135	174	9	135	460	0	135	468	0
136	18	21	136	35	25	136	105	13	136	178	7	136	209	0	136	217	0
137	22	11	137	27	8	137	93	14	137	184	31	137	245	0	137	253	0
138	0	2	138	35	15	138	85	0	138	146	23	138	281	0	138	289	0
139	3	1	139	25	31	139	74	27	139	139	3	139	317	0	139	325	0
140	8	9	140	40	24	140	88	20	140	157	14	140	353	0	140	361	0
141	8	20	141	30	11	141	66	5	141	165	6	141	389	0	141	397	0
142	8	14	142	27	31	142	56	16	142	144	11	142	425	0	142	433	0
143	10	3	143	32	6	143	61	17	143	175	9	143	461	0	143	469	0
144	19	21	144	36	25	144	106	13	144	179	7	144	210	0	144	218	0
145	23	11	145	28	8	145	94	14	145	185	31	145	246	0	145	254	0
146	1	2	146	36	15	146	86	0	146	147	23	146	282	0	146	290	0
147	4	1	147	26	31	147	75	27	147	140	3	147	318	0	147	326	0
148	9	9	148	41	24	148	89	20	148	158	14	148	354	0	148	362	0
149	9	20	149	31	11	149	67	5	149	166	6	149	390	0	149	398	0
150	9	14	150	28	31	150	57	16	150	145	11	150	426	0	150	434	0
151	11	3	151	33	6	151	62	17	151	168	10	151	462	0	151	470	0
152	20	21	152	37	25	152	107	13	152	180	7	152	211	0	152	219	0
153	16	12	153	29	8	153	95	14	153	186	31	153	247	0	153	255	0
154	2	2	154	37	15	154	87	0	154	148	23	154	283	0	154	291	0
155	5	1	155	27	31	155	76	27	155	141	3	155	319	0	155	327	0

156	10	9	156	42	24	156	90	20	156	159	14	156	355	0	156	363	0
157	10	20	157	24	12	157	68	5	157	167	6	157	391	0	157	399	0
158	10	14	158	29	31	158	58	16	158	146	11	158	427	0	158	435	0
159	12	3	159	34	6	159	63	17	159	169	10	159	463	0	159	471	0
160	21	21	160	38	25	160	108	13	160	181	7	160	212	0	160	220	0
161	10	26	161	36	3	161	97	17	161	158	15	161	248	0	161	256	0
162	3	2	162	38	15	162	80	1	162	149	23	162	284	0	162	292	0
163	2	28	163	35	23	163	78	2	163	152	30	163	320	0	163	328	0
164	11	9	164	43	24	164	91	20	164	152	15	164	356	0	164	364	0
165	5	24	165	22	15	165	45	2	165	54	29	165	165	8	165	392	0
165	400	0	166	11	14	166	30	31	166	59	16	166	147	11	166	428	0
166	436	0	167	26	29	167	95	19	167	128	13	167	464	0	167	472	0
168	22	21	168	39	25	168	109	13	168	182	7	168	213	0	168	221	0
169	11	26	169	37	3	169	98	17	169	159	15	169	249	0	169	257	0
170	4	2	170	39	15	170	81	1	170	150	23	170	285	0	170	293	0
171	3	28	171	36	23	171	79	2	171	153	30	171	321	0	171	329	0
172	12	9	172	44	24	172	92	20	172	153	15	172	357	0	172	365	0
173	6	24	173	23	15	173	46	2	173	55	29	173	166	8	173	393	0
173	401	0	174	12	14	174	31	31	174	60	16	174	148	11	174	429	0
174	437	0	175	27	29	175	88	20	175	129	13	175	465	0	175	473	0
176	23	21	176	32	26	176	110	13	176	183	7	176	214	0	176	222	0
177	12	26	177	38	3	177	99	17	177	152	16	177	250	0	177	258	0
178	5	2	178	32	16	178	82	1	178	151	23	178	286	0	178	294	0
179	4	28	179	37	23	179	72	3	179	154	30	179	322	0	179	330	0
180	13	9	180	45	24	180	93	20	180	154	15	180	358	0	180	366	0
181	7	24	181	16	16	181	47	2	181	48	30	181	167	8	181	394	0
181	402	0	182	13	14	182	24	0	182	61	16	182	149	11	182	430	0
182	438	0	183	28	29	183	89	20	183	130	13	183	466	0	183	474	0
184	16	22	184	33	26	184	111	13	184	176	8	184	215	0	184	223	0
185	13	26	185	39	3	185	100	17	185	153	16	185	251	0	185	259	0
186	6	2	186	33	16	186	83	1	186	144	24	186	287	0	186	295	0
187	5	28	187	38	23	187	73	3	187	155	30	187	323	0	187	331	0
188	14	9	188	46	24	188	94	20	188	155	15	188	359	0	188	367	0
189	0	25	189	17	16	189	40	3	189	49	30	189	160	9	189	395	0
189	403	0	190	14	14	190	25	0	190	62	16	190	150	11	190	431	0
190	439	0	191	29	29	191	90	20	191	131	13	191	467	0	191	475	0
192	1	20	192	19	18	192	39	12	192	122	1	192	171	28	192	216	0
192	224	0	193	14	26	193	32	4	193	101	17	193	154	16	193	252	0
193	260	0	194	36	9	194	110	19	194	183	11	194	288	0	194	296	0
195	6	28	195	39	23	195	74	3	195	156	30	195	324	0	195	332	0
196	0	31	196	46	5	196	72	5	196	141	10	196	360	0	196	368	0
197	1	25	197	18	16	197	41	3	197	50	30	197	161	9	197	396	0
197	404	0	198	21	10	198	40	29	198	50	5	198	125	2	198	432	0
198	440	0	199	30	29	199	91	20	199	132	13	199	468	0	199	476	0
200	2	20	200	20	18	200	32	13	200	123	1	200	172	28	200	217	0
200	225	0	201	15	26	201	33	4	201	102	17	201	155	16	201	253	0
201	261	0	202	37	9	202	111	19	202	176	12	202	289	0	202	297	0
203	7	28	203	32	24	203	75	3	203	157	30	203	325	0	203	333	0
204	1	31	204	47	5	204	73	5	204	142	10	204	361	0	204	369	0
205	2	25	205	19	16	205	42	3	205	51	30	205	162	9	205	397	0
205	405	0	206	22	10	206	41	29	206	51	5	206	126	2	206	433	0
206	441	0	207	31	29	207	92	20	207	133	13	207	469	0	207	477	0
208	3	20	208	21	18	208	33	13	208	124	1	208	173	28	208	218	0

208	226	0	209	8	27	209	34	4	209	103	17	209	156	16	209	254	0
209	262	0	210	38	9	210	104	20	210	177	12	210	290	0	210	298	0
211	0	29	211	33	24	211	76	3	211	158	30	211	326	0	211	334	0
212	2	31	212	40	6	212	74	5	212	143	10	212	362	0	212	370	0
213	3	25	213	20	16	213	43	3	213	52	30	213	163	9	213	398	0
213	406	0	214	23	10	214	42	29	214	52	5	214	127	2	214	434	0
214	442	0	215	24	30	215	93	20	215	134	13	215	470	0	215	478	0
216	4	20	216	22	18	216	34	13	216	125	1	216	174	28	216	219	0
216	227	0	217	9	27	217	35	4	217	96	18	217	157	16	217	255	0
217	263	0	218	39	9	218	105	20	218	178	12	218	291	0	218	299	0
219	1	29	219	34	24	219	77	3	219	159	30	219	327	0	219	335	0
220	3	31	220	41	6	220	75	5	220	136	11	220	363	0	220	371	0
221	4	25	221	21	16	221	44	3	221	53	30	221	164	9	221	399	0
221	407	0	222	16	11	222	43	29	222	53	5	222	120	3	222	435	0
222	443	0	223	25	30	223	94	20	223	135	13	223	471	0	223	479	0
224	5	20	224	23	18	224	35	13	224	126	1	224	175	28	224	220	0
224	228	0	225	26	22	225	45	23	225	85	1	225	167	18	225	256	0
225	264	0	226	32	10	226	106	20	226	179	12	226	292	0	226	300	0
227	15	1	227	24	11	227	64	30	227	128	12	227	328	0	227	336	0
228	4	31	228	42	6	228	76	5	228	137	11	228	364	0	228	372	0
229	0	20	229	41	3	229	94	10	229	122	20	229	400	0	229	408	0
230	17	11	230	44	29	230	54	5	230	121	3	230	436	0	230	444	0
231	7	7	231	23	23	231	44	19	231	51	17	231	127	1	231	194	0
231	472	0	232	6	20	232	16	19	232	36	13	232	127	1	232	168	29
232	221	0	232	229	0	233	27	22	233	46	23	233	86	1	233	160	19
233	257	0	233	265	0	234	33	10	234	107	20	234	180	12	234	293	0
234	301	0	235	8	2	235	25	11	235	65	30	235	129	12	235	329	0
235	337	0	236	5	31	236	43	6	236	77	5	236	138	11	236	365	0
236	373	0	237	1	20	237	42	3	237	95	10	237	123	20	237	401	0
237	409	0	238	18	11	238	45	29	238	55	5	238	122	3	238	437	0
238	445	0	239	0	8	239	16	24	239	45	19	239	52	17	239	120	2
239	195	0	239	473	0	240	7	20	240	17	19	240	37	13	240	120	2
240	169	29	240	222	0	240	230	0	241	28	22	241	47	23	241	87	1
241	161	19	241	258	0	241	266	0	242	34	10	242	108	20	242	181	12
242	294	0	242	302	0	243	9	2	243	26	11	243	66	30	243	130	12
243	330	0	243	338	0	244	6	31	244	44	6	244	78	5	244	139	11
244	366	0	244	374	0	245	2	20	245	43	3	245	88	11	245	124	20
245	402	0	245	410	0	246	19	11	246	46	29	246	48	6	246	123	3
246	438	0	246	446	0	247	1	8	247	17	24	247	46	19	247	53	17
247	121	2	247	196	0	247	474	0	248	0	21	248	18	19	248	38	13
248	121	2	248	170	29	248	223	0	248	231	0	249	29	22	249	40	24
249	80	2	249	162	19	249	259	0	249	267	0	250	35	10	250	109	20
250	182	12	250	295	0	250	303	0	251	10	2	251	27	11	251	67	30
251	131	12	251	331	0	251	339	0	252	7	31	252	45	6	252	79	5
252	140	11	252	367	0	252	375	0	253	3	20	253	44	3	253	89	11
253	125	20	253	403	0	253	411	0	254	20	11	254	47	29	254	49	6
254	124	3	254	439	0	254	447	0	255	2	8	255	18	24	255	47	19
255	54	17	255	122	2	255	197	0	255	475	0	256	8	23	256	33	20
256	101	28	256	171	13	256	224	0	256	232	0	257	30	22	257	41	24
257	81	2	257	163	19	257	260	0	257	268	0	258	8	11	258	44	2
258	76	27	258	178	8	258	296	0	258	304	0	259	11	2	259	28	11
259	68	30	259	132	12	259	332	0	259	340	0	260	23	15	260	24	26
260	57	11	260	190	13	260	368	0	260	376	0	261	4	20	261	45	3

261	90	11	261	126	20	261	404	0	261	412	0	262	18	20	262	48	27
262	104	23	262	174	23	262	440	0	262	448	0	263	3	8	263	19	24
263	40	20	263	55	17	263	123	2	263	198	0	263	476	0	264	9	23
264	34	20	264	102	28	264	172	13	264	225	0	264	233	0	265	31	22
265	42	24	265	82	2	265	164	19	265	261	0	265	269	0	266	9	11
266	45	2	266	77	27	266	179	8	266	297	0	266	305	0	267	12	2
267	29	11	267	69	30	267	133	12	267	333	0	267	341	0	268	16	16
268	25	26	268	58	11	268	191	13	268	369	0	268	377	0	269	5	20
269	46	3	269	91	11	269	127	20	269	405	0	269	413	0	270	19	20
270	49	27	270	105	23	270	175	23	270	441	0	270	449	0	271	4	8
271	20	24	271	41	20	271	48	18	271	124	2	271	199	0	271	477	0
272	10	23	272	35	20	272	103	28	272	173	13	272	226	0	272	234	0
273	24	23	273	43	24	273	83	2	273	165	19	273	262	0	273	270	0
274	10	11	274	46	2	274	78	27	274	180	8	274	298	0	274	306	0
275	13	2	275	30	11	275	70	30	275	134	12	275	334	0	275	342	0
276	17	16	276	26	26	276	59	11	276	184	14	276	370	0	276	378	0
277	6	20	277	47	3	277	92	11	277	120	21	277	406	0	277	414	0
278	20	20	278	50	27	278	106	23	278	168	24	278	442	0	278	450	0
279	5	8	279	21	24	279	42	20	279	49	18	279	125	2	279	192	1
279	478	0	280	11	23	280	36	20	280	96	29	280	174	13	280	227	0
280	235	0	281	25	23	281	44	24	281	84	2	281	166	19	281	263	0
281	271	0	282	11	11	282	47	2	282	79	27	282	181	8	282	299	0
282	307	0	283	14	2	283	31	11	283	71	30	283	135	12	283	335	0
283	343	0	284	18	16	284	27	26	284	60	11	284	185	14	284	371	0
284	379	0	285	7	20	285	40	4	285	93	11	285	121	21	285	407	0
285	415	0	286	21	20	286	51	27	286	107	23	286	169	24	286	443	0
286	451	0	287	6	8	287	22	24	287	43	20	287	50	18	287	126	2
287	193	1	287	479	0												

Appendix Table C: Specification of the base matrix $B_{\frac{1}{2}}$ for the rate-1/2 LDPC code

0	6	16	0	24	12	0	42	16	0	101	9	0	153	21	0	234	3
0	240	0	0	248	0	1	15	24	1	21	1	1	42	30	1	93	17
1	155	15	1	228	29	1	270	0	1	278	0	2	20	3	2	54	19
2	73	23	2	146	2	2	211	18	2	300	0	2	308	0	3	28	23
3	44	13	3	84	3	3	153	11	3	205	0	3	330	0	3	338	0
4	4	29	4	14	22	4	45	25	4	77	28	4	129	9	4	241	0
4	360	0	4	368	0	5	4	13	5	25	22	5	32	8	5	56	30
5	146	9	5	238	8	5	390	0	5	398	0	6	0	4	6	10	6
6	35	29	6	54	7	6	166	23	6	219	0	6	420	0	6	428	0
7	16	0	7	26	29	7	52	1	7	107	11	7	171	5	7	450	0
7	458	0	8	7	16	8	25	12	8	43	16	8	102	9	8	154	21
8	235	3	8	241	0	8	249	0	9	8	25	9	22	1	9	43	30
9	94	17	9	156	15	9	229	29	9	271	0	9	279	0	10	21	3
10	55	19	10	74	23	10	147	2	10	212	18	10	301	0	10	309	0
11	29	23	11	45	13	11	85	3	11	154	11	11	206	0	11	331	0
11	339	0	12	5	29	12	15	22	12	46	25	12	78	28	12	130	9
12	242	0	12	361	0	12	369	0	13	5	13	13	26	22	13	33	8
13	57	30	13	147	9	13	239	8	13	391	0	13	399	0	14	1	4
14	11	6	14	36	29	14	55	7	14	167	23	14	220	0	14	421	0
14	429	0	15	17	0	15	27	29	15	53	1	15	108	11	15	172	5
15	451	0	15	459	0	16	0	17	16	26	12	16	44	16	16	103	9
16	155	21	16	236	3	16	242	0	16	250	0	17	15	18	17	28	26
17	32	25	17	85	24	17	136	0	17	208	0	17	272	0	17	280	0
18	22	3	18	48	20	18	75	23	18	148	2	18	213	18	18	302	0
18	310	0	19	30	23	19	46	13	19	86	3	19	155	11	19	207	0
19	332	0	19	340	0	20	6	29	20	8	23	20	47	25	20	79	28
20	131	9	20	243	0	20	362	0	20	370	0	21	14	1	21	50	7
21	59	1	21	145	2	21	187	27	21	392	0	21	400	0	22	2	4
22	12	6	22	37	29	22	48	8	22	160	24	22	221	0	22	422	0
22	430	0	23	18	0	23	28	29	23	54	1	23	109	11	23	173	5
23	452	0	23	460	0	24	1	17	24	27	12	24	45	16	24	96	10
24	156	21	24	237	3	24	243	0	24	251	0	25	8	19	25	29	26
25	33	25	25	86	24	25	137	0	25	209	0	25	273	0	25	281	0
26	23	3	26	49	20	26	76	23	26	149	2	26	214	18	26	303	0
26	311	0	27	31	23	27	47	13	27	87	3	27	156	11	27	200	1
27	333	0	27	341	0	28	7	29	28	9	23	28	40	26	28	72	29
28	132	9	28	244	0	28	363	0	28	371	0	29	15	1	29	51	7
29	60	1	29	146	2	29	188	27	29	393	0	29	401	0	30	3	4
30	13	6	30	38	29	30	49	8	30	161	24	30	222	0	30	423	0
30	431	0	31	19	0	31	29	29	31	55	1	31	110	11	31	174	5
31	453	0	31	461	0	32	2	17	32	28	12	32	46	16	32	97	10
32	157	21	32	238	3	32	244	0	32	252	0	33	9	19	33	30	26
33	34	25	33	87	24	33	138	0	33	210	0	33	274	0	33	282	0
34	17	29	34	52	6	34	68	8	34	152	9	34	193	0	34	304	0
34	312	0	35	24	24	35	40	14	35	80	4	35	157	11	35	201	1
35	334	0	35	342	0	36	0	30	36	10	23	36	41	26	36	73	29
36	133	9	36	245	0	36	364	0	36	372	0	37	8	2	37	52	7
37	61	1	37	147	2	37	189	27	37	394	0	37	402	0	38	0	11
38	8	6	38	54	21	38	97	23	38	121	16	38	168	6	38	424	0
38	432	0	39	20	0	39	30	29	39	48	2	39	111	11	39	175	5

39	454	0	39	462	0	40	3	17	40	29	12	40	47	16	40	98	10
40	158	21	40	239	3	40	245	0	40	253	0	41	10	19	41	31	26
41	35	25	41	80	25	41	139	0	41	211	0	41	275	0	41	283	0
42	18	29	42	53	6	42	69	8	42	153	9	42	194	0	42	305	0
42	313	0	43	25	24	43	41	14	43	81	4	43	158	11	43	202	1
43	335	0	43	343	0	44	1	30	44	11	23	44	42	26	44	74	29
44	134	9	44	246	0	44	365	0	44	373	0	45	9	2	45	53	7
45	62	1	45	148	2	45	190	27	45	395	0	45	403	0	46	1	11
46	9	6	46	55	21	46	98	23	46	122	16	46	169	6	46	425	0
46	433	0	47	21	0	47	31	29	47	49	2	47	104	12	47	168	6
47	455	0	47	463	0	48	4	17	48	30	12	48	40	17	48	99	10
48	159	21	48	232	4	48	246	0	48	254	0	49	11	19	49	24	27
49	36	25	49	81	25	49	140	0	49	212	0	49	276	0	49	284	0
50	19	29	50	54	6	50	70	8	50	154	9	50	195	0	50	306	0
50	314	0	51	20	24	51	29	25	51	55	16	51	58	17	51	123	16
51	186	16	51	336	0	51	344	0	52	2	30	52	12	23	52	43	26
52	75	29	52	135	9	52	247	0	52	366	0	52	374	0	53	10	2
53	54	7	53	63	1	53	149	2	53	191	27	53	396	0	53	404	0
54	2	11	54	10	6	54	48	22	54	99	23	54	123	16	54	170	6
54	426	0	54	434	0	55	21	9	55	37	14	55	105	16	55	138	31
55	183	18	55	456	0	55	464	0	56	5	17	56	31	12	56	41	17
56	100	10	56	152	22	56	233	4	56	247	0	56	255	0	57	12	19
57	25	27	57	37	25	57	82	25	57	141	0	57	213	0	57	277	0
57	285	0	58	20	29	58	55	6	58	71	8	58	155	9	58	196	0
58	307	0	58	315	0	59	21	24	59	30	25	59	48	17	59	59	17
59	124	16	59	187	16	59	337	0	59	345	0	60	3	30	60	13	23
60	44	26	60	76	29	60	128	10	60	240	1	60	367	0	60	375	0
61	11	2	61	55	7	61	56	2	61	150	2	61	184	28	61	397	0
61	405	0	62	3	11	62	11	6	62	49	22	62	100	23	62	124	16
62	171	6	62	427	0	62	435	0	63	22	9	63	38	14	63	106	16
63	139	31	63	176	19	63	457	0	63	465	0	64	5	0	64	22	16
64	40	23	64	99	15	64	147	18	64	230	15	64	248	0	64	256	0
65	13	19	65	26	27	65	38	25	65	83	25	65	142	0	65	214	0
65	278	0	65	286	0	66	21	29	66	48	7	66	64	9	66	156	9
66	197	0	66	308	0	66	316	0	67	22	24	67	31	25	67	49	17
67	60	17	67	125	16	67	188	16	67	338	0	67	346	0	68	3	20
68	24	6	68	45	11	68	68	3	68	135	18	68	197	4	68	368	0
68	376	0	69	12	2	69	48	8	69	57	2	69	151	2	69	185	28
69	398	0	69	406	0	70	4	11	70	12	6	70	50	22	70	101	23
70	125	16	70	172	6	70	428	0	70	436	0	71	23	9	71	39	14
71	107	16	71	140	31	71	177	19	71	458	0	71	466	0	72	6	0
72	23	16	72	41	23	72	100	15	72	148	18	72	231	15	72	249	0
72	257	0	73	14	19	73	27	27	73	39	25	73	84	25	73	143	0
73	215	0	73	279	0	73	287	0	74	22	29	74	49	7	74	65	9
74	157	9	74	198	0	74	309	0	74	317	0	75	23	24	75	24	26
75	50	17	75	61	17	75	126	16	75	189	16	75	339	0	75	347	0
76	4	20	76	25	6	76	46	11	76	69	3	76	128	19	76	198	4
76	369	0	76	377	0	77	13	2	77	49	8	77	58	2	77	144	3
77	186	28	77	399	0	77	407	0	78	5	11	78	13	6	78	51	22
78	102	23	78	126	16	78	173	6	78	429	0	78	437	0	79	16	10
79	32	15	79	108	16	79	141	31	79	178	19	79	459	0	79	467	0
80	7	0	80	16	17	80	42	23	80	101	15	80	149	18	80	224	16
80	250	0	80	258	0	81	5	0	81	27	0	81	44	31	81	91	31

81	131	10	81	237	24	81	280	0	81	288	0	82	23	29	82	50	7
82	66	9	82	158	9	82	199	0	82	310	0	82	318	0	83	16	25
83	25	26	83	51	17	83	62	17	83	127	16	83	190	16	83	340	0
83	348	0	84	5	20	84	26	6	84	47	11	84	70	3	84	129	19
84	199	4	84	370	0	84	378	0	85	14	12	85	25	20	85	54	9
85	101	30	85	126	7	85	191	14	85	400	0	85	408	0	86	6	11
86	14	6	86	52	22	86	103	23	86	127	16	86	174	6	86	430	0
86	438	0	87	17	10	87	33	15	87	109	16	87	142	31	87	179	19
87	460	0	87	468	0	88	0	1	88	17	17	88	43	23	88	102	15
88	150	18	88	225	16	88	251	0	88	259	0	89	6	0	89	28	0
89	45	31	89	92	31	89	132	10	89	238	24	89	281	0	89	289	0
90	16	30	90	51	7	90	67	9	90	159	9	90	192	1	90	311	0
90	319	0	91	17	25	91	26	26	91	52	17	91	63	17	91	120	17
91	191	16	91	341	0	91	349	0	92	6	20	92	27	6	92	40	12
92	71	3	92	130	19	92	192	5	92	371	0	92	379	0	93	15	12
93	26	20	93	55	9	93	102	30	93	127	7	93	184	15	93	401	0
93	409	0	94	7	11	94	15	6	94	53	22	94	96	24	94	120	17
94	175	6	94	431	0	94	439	0	95	18	10	95	34	15	95	110	16
95	143	31	95	180	19	95	461	0	95	469	0	96	1	1	96	18	17
96	44	23	96	103	15	96	151	18	96	226	16	96	252	0	96	260	0
97	7	0	97	29	0	97	46	31	97	93	31	97	133	10	97	239	24
97	282	0	97	290	0	98	16	2	98	44	11	98	91	8	98	129	5
98	196	9	98	312	0	98	320	0	99	18	25	99	27	26	99	53	17
99	56	18	99	121	17	99	184	17	99	342	0	99	350	0	100	7	20
100	28	6	100	41	12	100	64	4	100	131	19	100	193	5	100	372	0
100	380	0	101	8	13	101	27	20	101	48	10	101	103	30	101	120	8
101	185	15	101	402	0	101	410	0	102	7	9	102	19	25	102	50	11
102	75	27	102	160	28	102	220	29	102	432	0	102	440	0	103	19	10
103	35	15	103	111	16	103	136	0	103	181	19	103	462	0	103	470	0
104	2	1	104	19	17	104	45	23	104	96	16	104	144	19	104	227	16
104	253	0	104	261	0	105	0	1	105	30	0	105	47	31	105	94	31
105	134	10	105	232	25	105	283	0	105	291	0	106	17	2	106	45	11
106	92	8	106	130	5	106	197	9	106	313	0	106	321	0	107	19	25
107	28	26	107	54	17	107	57	18	107	122	17	107	185	17	107	343	0
107	351	0	108	0	21	108	29	6	108	42	12	108	65	4	108	132	19
108	194	5	108	373	0	108	381	0	109	9	13	109	28	20	109	49	10
109	96	31	109	121	8	109	186	15	109	403	0	109	411	0	110	0	10
110	20	25	110	51	11	110	76	27	110	161	28	110	221	29	110	433	0
110	441	0	111	20	10	111	36	15	111	104	17	111	137	0	111	182	19
111	463	0	111	471	0	112	3	1	112	20	17	112	46	23	112	97	16
112	145	19	112	228	16	112	254	0	112	262	0	113	1	1	113	31	0
113	40	0	113	95	31	113	135	10	113	233	25	113	284	0	113	292	0
114	18	2	114	46	11	114	93	8	114	131	5	114	198	9	114	314	0
114	322	0	115	19	14	115	24	11	115	34	31	115	84	18	115	137	12
115	206	4	115	344	0	115	352	0	116	1	21	116	30	6	116	43	12
116	66	4	116	133	19	116	195	5	116	374	0	116	382	0	117	10	13
117	29	20	117	50	10	117	97	31	117	122	8	117	187	15	117	404	0
117	412	0	118	1	10	118	21	25	118	52	11	118	77	27	118	162	28
118	222	29	118	434	0	118	442	0	119	8	20	119	38	17	119	45	24
119	72	22	119	117	0	119	181	7	119	464	0	119	472	0	120	4	1
120	21	17	120	47	23	120	98	16	120	146	19	120	229	16	120	255	0
120	263	0	121	2	1	121	24	1	121	41	0	121	88	0	121	128	11
121	234	25	121	285	0	121	293	0	122	19	2	122	47	11	122	94	8

122	132	5	122	199	9	122	315	0	122	323	0	123	20	14	123	25	11
123	35	31	123	85	18	123	138	12	123	207	4	123	345	0	123	353	0
124	2	21	124	31	6	124	44	12	124	67	4	124	134	19	124	196	5
124	375	0	124	383	0	125	11	13	125	30	20	125	51	10	125	98	31
125	123	8	125	188	15	125	405	0	125	413	0	126	2	10	126	22	25
126	53	11	126	78	27	126	163	28	126	223	29	126	435	0	126	443	0
127	9	20	127	39	17	127	46	24	127	73	22	127	118	0	127	182	7
127	465	0	127	473	0	128	2	22	128	32	0	128	45	8	128	93	27
128	162	18	128	221	27	128	256	0	128	264	0	129	3	1	129	25	1
129	42	0	129	89	0	129	129	11	129	235	25	129	286	0	129	294	0
130	20	2	130	40	12	130	95	8	130	133	5	130	192	10	130	316	0
130	324	0	131	21	14	131	26	11	131	36	31	131	86	18	131	139	12
131	200	5	131	346	0	131	354	0	132	0	31	132	10	7	132	38	7
132	70	21	132	106	23	132	168	29	132	376	0	132	384	0	133	12	13
133	31	20	133	52	10	133	99	31	133	124	8	133	189	15	133	406	0
133	414	0	134	3	10	134	23	25	134	54	11	134	79	27	134	164	28
134	216	30	134	436	0	134	444	0	135	10	20	135	32	18	135	47	24
135	74	22	135	119	0	135	183	7	135	466	0	135	474	0	136	3	22
136	33	0	136	46	8	136	94	27	136	163	18	136	222	27	136	257	0
136	265	0	137	4	1	137	26	1	137	43	0	137	90	0	137	130	11
137	236	25	137	287	0	137	295	0	138	21	2	138	41	12	138	88	9
138	134	5	138	193	10	138	317	0	138	325	0	139	22	14	139	27	11
139	37	31	139	87	18	139	140	12	139	201	5	139	347	0	139	355	0
140	1	31	140	11	7	140	39	7	140	71	21	140	107	23	140	169	29
140	377	0	140	385	0	141	13	13	141	24	21	141	53	10	141	100	31
141	125	8	141	190	15	141	407	0	141	415	0	142	4	10	142	16	26
142	55	11	142	72	28	142	165	28	142	217	30	142	437	0	142	445	0
143	11	20	143	33	18	143	40	25	143	75	22	143	112	1	143	176	8
143	467	0	143	475	0	144	4	22	144	34	0	144	47	8	144	95	27
144	164	18	144	223	27	144	258	0	144	266	0	145	26	6	145	35	5
145	84	7	145	121	9	145	206	14	145	288	0	145	296	0	146	22	2
146	42	12	146	89	9	146	135	5	146	194	10	146	318	0	146	326	0
147	23	14	147	28	11	147	38	31	147	80	19	147	141	12	147	202	5
147	348	0	147	356	0	148	2	31	148	12	7	148	32	8	148	64	22
148	108	23	148	170	29	148	378	0	148	386	0	149	13	20	149	32	11
149	55	27	149	139	12	149	170	15	149	408	0	149	416	0	150	5	10
150	17	26	150	48	12	150	73	28	150	166	28	150	218	30	150	438	0
150	446	0	151	12	20	151	34	18	151	41	25	151	76	22	151	113	1
151	177	8	151	468	0	151	476	0	152	5	22	152	35	0	152	40	9
152	88	28	152	165	18	152	216	28	152	259	0	152	267	0	153	27	6
153	36	5	153	85	7	153	122	9	153	207	14	153	289	0	153	297	0
154	23	2	154	43	12	154	90	9	154	128	6	154	195	10	154	319	0
154	327	0	155	16	15	155	29	11	155	39	31	155	81	19	155	142	12
155	203	5	155	349	0	155	357	0	156	3	31	156	13	7	156	33	8
156	65	22	156	109	23	156	171	29	156	379	0	156	387	0	157	14	20
157	33	11	157	48	28	157	140	12	157	171	15	157	409	0	157	417	0
158	6	10	158	18	26	158	49	12	158	74	28	158	167	28	158	219	30
158	439	0	158	447	0	159	13	20	159	35	18	159	42	25	159	77	22
159	114	1	159	178	8	159	469	0	159	477	0	160	6	22	160	36	0
160	41	9	160	89	28	160	166	18	160	217	28	160	260	0	160	268	0
161	28	6	161	37	5	161	86	7	161	123	9	161	200	15	161	290	0
161	298	0	162	9	13	162	26	25	162	44	9	162	68	25	162	119	14
162	228	2	162	320	0	162	328	0	163	17	15	163	30	11	163	32	0

163	82	19	163	143	12	163	204	5	163	350	0	163	358	0	164	4	31
164	14	7	164	34	8	164	66	22	164	110	23	164	172	29	164	380	0
164	388	0	165	15	20	165	34	11	165	49	28	165	141	12	165	172	15
165	410	0	165	418	0	166	23	5	166	37	10	166	53	31	166	116	5
166	209	25	166	440	0	166	448	0	167	14	20	167	36	18	167	43	25
167	78	22	167	115	1	167	179	8	167	470	0	167	478	0	168	7	22
168	37	0	168	42	9	168	90	28	168	167	18	168	218	28	168	261	0
168	269	0	169	29	6	169	38	5	169	87	7	169	124	9	169	201	15
169	291	0	169	299	0	170	10	13	170	27	25	170	45	9	170	69	25
170	112	15	170	229	2	170	321	0	170	329	0	171	18	15	171	31	11
171	33	0	171	83	19	171	136	13	171	205	5	171	351	0	171	359	0
172	5	31	172	15	7	172	35	8	172	67	22	172	111	23	172	173	29
172	381	0	172	389	0	173	8	21	173	35	11	173	50	28	173	142	12
173	173	15	173	411	0	173	419	0	174	16	6	174	38	10	174	54	31
174	117	5	174	210	25	174	441	0	174	449	0	175	15	20	175	37	18
175	44	25	175	79	22	175	116	1	175	180	8	175	471	0	175	479	0
176	0	23	176	38	0	176	43	9	176	91	28	176	160	19	176	219	28
176	262	0	176	270	0	177	30	6	177	39	5	177	80	8	177	125	9
177	202	15	177	292	0	177	300	0	178	11	13	178	28	25	178	46	9
178	70	25	178	113	15	178	230	2	178	322	0	178	330	0	179	6	26
179	22	0	179	41	25	179	60	4	179	105	21	179	176	31	179	352	0
179	360	0	180	6	31	180	8	8	180	36	8	180	68	22	180	104	24
180	174	29	180	382	0	180	390	0	181	9	21	181	36	11	181	51	28
181	143	12	181	174	15	181	412	0	181	420	0	182	17	6	182	39	10
182	55	31	182	118	5	182	211	25	182	442	0	182	450	0	183	9	15
183	37	19	183	48	3	183	118	12	183	165	12	183	242	0	183	472	0
184	1	23	184	39	0	184	44	9	184	92	28	184	161	19	184	220	28
184	263	0	184	271	0	185	31	6	185	32	6	185	81	8	185	126	9
185	203	15	185	293	0	185	301	0	186	12	13	186	29	25	186	47	9
186	71	25	186	114	15	186	231	2	186	323	0	186	331	0	187	7	26
187	23	0	187	42	25	187	61	4	187	106	21	187	177	31	187	353	0
187	361	0	188	7	31	188	9	8	188	37	8	188	69	22	188	105	24
188	175	29	188	383	0	188	391	0	189	10	21	189	37	11	189	52	28
189	136	13	189	175	15	189	413	0	189	421	0	190	18	6	190	32	11
190	48	0	190	119	5	190	212	25	190	443	0	190	451	0	191	10	15
191	38	19	191	49	3	191	119	12	191	166	12	191	243	0	191	473	0
192	9	24	192	23	0	192	44	29	192	95	16	192	157	14	192	230	28
192	264	0	192	272	0	193	24	7	193	33	6	193	82	8	193	127	9
193	204	15	193	294	0	193	302	0	194	13	13	194	30	25	194	40	10
194	64	26	194	115	15	194	224	3	194	324	0	194	332	0	195	0	27
195	16	1	195	43	25	195	62	4	195	107	21	195	178	31	195	354	0
195	362	0	196	6	12	196	27	21	196	34	7	196	58	29	196	148	8
196	232	8	196	384	0	196	392	0	197	11	21	197	38	11	197	53	28
197	137	13	197	168	16	197	414	0	197	422	0	198	19	6	198	33	11
198	49	0	198	112	6	198	213	25	198	444	0	198	452	0	199	11	15
199	39	19	199	50	3	199	112	13	199	167	12	199	244	0	199	474	0
200	10	24	200	16	1	200	45	29	200	88	17	200	158	14	200	231	28
200	265	0	200	273	0	201	25	7	201	34	6	201	83	8	201	120	10
201	205	15	201	295	0	201	303	0	202	14	13	202	31	25	202	41	10
202	65	26	202	116	15	202	225	3	202	325	0	202	333	0	203	1	27
203	17	1	203	44	25	203	63	4	203	108	21	203	179	31	203	355	0
203	363	0	204	7	12	204	28	21	204	35	7	204	59	29	204	149	8
204	233	8	204	385	0	204	393	0	205	12	21	205	39	11	205	54	28

205	138	13	205	169	16	205	415	0	205	423	0	206	20	6	206	34	11
206	50	0	206	113	6	206	214	25	206	445	0	206	453	0	207	12	15
207	32	20	207	51	3	207	113	13	207	160	13	207	245	0	207	475	0
208	11	24	208	17	1	208	46	29	208	89	17	208	159	14	208	224	29
208	266	0	208	274	0	209	16	3	209	50	19	209	77	22	209	150	1
209	215	17	209	296	0	209	304	0	210	15	13	210	24	26	210	42	10
210	66	26	210	117	15	210	226	3	210	326	0	210	334	0	211	2	27
211	18	1	211	45	25	211	56	5	211	109	21	211	180	31	211	356	0
211	364	0	212	0	13	212	29	21	212	36	7	212	60	29	212	150	8
212	234	8	212	386	0	212	394	0	213	4	3	213	14	5	213	39	28
213	50	7	213	162	23	213	223	31	213	416	0	213	424	0	214	21	6
214	35	11	214	51	0	214	114	6	214	215	25	214	446	0	214	454	0
215	13	15	215	33	20	215	52	3	215	114	13	215	161	13	215	246	0
215	476	0	216	12	24	216	18	1	216	47	29	216	90	17	216	152	15
216	225	29	216	267	0	216	275	0	217	17	3	217	51	19	217	78	22
217	151	1	217	208	18	217	297	0	217	305	0	218	8	14	218	25	26
218	43	10	218	67	26	218	118	15	218	227	3	218	327	0	218	335	0
219	3	27	219	19	1	219	46	25	219	57	5	219	110	21	219	181	31
219	357	0	219	365	0	220	1	13	220	30	21	220	37	7	220	61	29
220	151	8	220	235	8	220	387	0	220	395	0	221	5	3	221	15	5
221	32	29	221	51	7	221	163	23	221	216	0	221	417	0	221	425	0
222	22	6	222	36	11	222	52	0	222	115	6	222	208	26	222	447	0
222	455	0	223	14	15	223	34	20	223	53	3	223	115	13	223	162	13
223	247	0	223	477	0	224	13	24	224	19	1	224	40	30	224	91	17
224	153	15	224	226	29	224	268	0	224	276	0	225	18	3	225	52	19
225	79	22	225	144	2	225	209	18	225	298	0	225	306	0	226	26	23
226	42	13	226	82	3	226	159	10	226	203	0	226	328	0	226	336	0
227	4	27	227	20	1	227	47	25	227	58	5	227	111	21	227	182	31
227	358	0	227	366	0	228	2	13	228	31	21	228	38	7	228	62	29
228	144	9	228	236	8	228	388	0	228	396	0	229	6	3	229	8	6
229	33	29	229	52	7	229	164	23	229	217	0	229	418	0	229	426	0
230	22	31	230	24	29	230	50	1	230	105	11	230	169	5	230	448	0
230	456	0	231	15	15	231	35	20	231	54	3	231	116	13	231	163	13
231	240	1	231	478	0	232	14	24	232	20	1	232	41	30	232	92	17
232	154	15	232	227	29	232	269	0	232	277	0	233	19	3	233	53	19
233	72	23	233	145	2	233	210	18	233	299	0	233	307	0	234	27	23
234	43	13	234	83	3	234	152	11	234	204	0	234	329	0	234	337	0
235	5	27	235	21	1	235	40	26	235	59	5	235	104	22	235	183	31
235	359	0	235	367	0	236	3	13	236	24	22	236	39	7	236	63	29
236	145	9	236	237	8	236	389	0	236	397	0	237	7	3	237	9	6
237	34	29	237	53	7	237	165	23	237	218	0	237	419	0	237	427	0
238	23	31	238	25	29	238	51	1	238	106	11	238	170	5	238	449	0
238	457	0	239	8	16	239	36	20	239	55	3	239	117	13	239	164	13
239	241	1	239	479	0												

Appendix Table D: Specification of the base matrix $B_{\frac{3}{5}}$ for the rate-3/5 LDPC code

0	14	3	0	31	8	0	33	31	0	53	13	0	77	10	0	114	22
0	162	17	0	219	27	0	283	3	0	288	0	0	296	0	1	2	24
1	30	3	1	44	23	1	66	17	1	119	31	1	167	16	1	215	5
1	277	15	1	312	0	1	320	0	2	7	21	2	16	12	2	38	4
2	58	9	2	96	30	2	151	25	2	198	23	2	260	2	2	336	0
2	344	0	3	7	27	3	22	1	3	41	6	3	59	20	3	96	12
3	146	3	3	192	26	3	250	16	3	360	0	3	368	0	4	17	3
4	28	1	4	43	8	4	66	23	4	92	17	4	128	6	4	180	5
4	289	0	4	384	0	4	392	0	5	7	4	5	9	29	5	33	13
5	42	3	5	95	19	5	130	0	5	171	21	5	281	8	5	408	0
5	416	0	6	19	16	6	33	28	6	46	28	6	77	0	6	138	24
6	174	3	6	239	8	6	432	0	6	440	0	7	9	11	7	25	16
7	52	1	7	73	20	7	136	30	7	188	22	7	227	27	7	456	0
7	464	0	8	15	3	8	24	9	8	34	31	8	54	13	8	78	10
8	115	22	8	163	17	8	220	27	8	284	3	8	289	0	8	297	0
9	3	24	9	31	3	9	45	23	9	67	17	9	112	0	9	160	17
9	208	6	9	278	15	9	313	0	9	321	0	10	0	22	10	17	12
10	39	4	10	59	9	10	97	30	10	144	26	10	199	23	10	261	2
10	337	0	10	345	0	11	0	28	11	23	1	11	42	6	11	60	20
11	97	12	11	147	3	11	193	26	11	251	16	11	361	0	11	369	0
12	18	3	12	29	1	12	44	8	12	67	23	12	93	17	12	129	6
12	181	5	12	290	0	12	385	0	12	393	0	13	0	5	13	10	29
13	34	13	13	43	3	13	88	20	13	131	0	13	172	21	13	282	8
13	409	0	13	417	0	14	20	16	14	34	28	14	47	28	14	78	0
14	139	24	14	175	3	14	232	9	14	433	0	14	441	0	15	10	11
15	26	16	15	53	1	15	74	20	15	137	30	15	189	22	15	228	27
15	457	0	15	465	0	16	8	4	16	25	9	16	35	31	16	55	13
16	79	10	16	116	22	16	164	17	16	221	27	16	285	3	16	290	0
16	298	0	17	4	24	17	24	4	17	46	23	17	68	17	17	113	0
17	161	17	17	209	6	17	279	15	17	314	0	17	322	0	18	1	22
18	18	12	18	32	5	18	60	9	18	98	30	18	145	26	18	192	24
18	262	2	18	338	0	18	346	0	19	1	28	19	16	2	19	43	6
19	61	20	19	98	12	19	148	3	19	194	26	19	252	16	19	362	0
19	370	0	20	19	3	20	30	1	20	45	8	20	68	23	20	94	17
20	130	6	20	182	5	20	291	0	20	386	0	20	394	0	21	1	5
21	11	29	21	35	13	21	44	3	21	89	20	21	132	0	21	173	21
21	283	8	21	410	0	21	418	0	22	21	16	22	35	28	22	40	29
22	79	0	22	140	24	22	168	4	22	233	9	22	434	0	22	442	0
23	11	11	23	27	16	23	54	1	23	75	20	23	138	30	23	190	22
23	229	27	23	458	0	23	466	0	24	9	4	24	26	9	24	36	31
24	48	14	24	72	11	24	117	22	24	165	17	24	222	27	24	286	3
24	291	0	24	299	0	25	5	24	25	25	4	25	47	23	25	69	17
25	114	0	25	162	17	25	210	6	25	272	16	25	315	0	25	323	0
26	2	22	26	19	12	26	33	5	26	61	9	26	99	30	26	146	26
26	193	24	26	263	2	26	339	0	26	347	0	27	2	28	27	17	2
27	44	6	27	62	20	27	99	12	27	149	3	27	195	26	27	253	16
27	363	0	27	371	0	28	20	3	28	31	1	28	46	8	28	69	23
28	95	17	28	131	6	28	183	5	28	292	0	28	387	0	28	395	0
29	2	5	29	12	29	29	36	13	29	45	3	29	90	20	29	133	0
29	174	21	29	284	8	29	411	0	29	419	0	30	22	16	30	36	28

30	41	29	30	72	1	30	141	24	30	169	4	30	234	9	30	435	0
30	443	0	31	12	11	31	28	16	31	55	1	31	76	20	31	139	30
31	191	22	31	230	27	31	459	0	31	467	0	32	10	4	32	27	9
32	37	31	32	49	14	32	73	11	32	118	22	32	166	17	32	223	27
32	287	3	32	292	0	32	300	0	33	6	24	33	26	4	33	40	24
33	70	17	33	115	0	33	163	17	33	211	6	33	273	16	33	316	0
33	324	0	34	3	22	34	20	12	34	34	5	34	62	9	34	100	30
34	147	26	34	194	24	34	256	3	34	340	0	34	348	0	35	3	28
35	18	2	35	45	6	35	63	20	35	100	12	35	150	3	35	196	26
35	254	16	35	364	0	35	372	0	36	21	3	36	24	2	36	47	8
36	70	23	36	88	18	36	132	6	36	176	6	36	293	0	36	388	0
36	396	0	37	3	5	37	13	29	37	37	13	37	46	3	37	91	20
37	134	0	37	175	21	37	285	8	37	412	0	37	420	0	38	23	16
38	37	28	38	42	29	38	73	1	38	142	24	38	170	4	38	235	9
38	436	0	38	444	0	39	13	11	39	29	16	39	48	2	39	77	20
39	140	30	39	184	23	39	231	27	39	460	0	39	468	0	40	11	4
40	28	9	40	38	31	40	50	14	40	74	11	40	119	22	40	167	17
40	216	28	40	280	4	40	293	0	40	301	0	41	7	24	41	27	4
41	41	24	41	71	17	41	116	0	41	164	17	41	212	6	41	274	16
41	317	0	41	325	0	42	4	22	42	21	12	42	35	5	42	63	9
42	101	30	42	148	26	42	195	24	42	257	3	42	341	0	42	349	0
43	4	28	43	19	2	43	46	6	43	56	21	43	101	12	43	151	3
43	197	26	43	255	16	43	365	0	43	373	0	44	22	3	44	25	2
44	40	9	44	71	23	44	89	18	44	133	6	44	177	6	44	294	0
44	389	0	44	397	0	45	4	5	45	14	29	45	38	13	45	47	3
45	92	20	45	135	0	45	168	22	45	286	8	45	413	0	45	421	0
46	16	17	46	38	28	46	43	29	46	74	1	46	143	24	46	171	4
46	236	9	46	437	0	46	445	0	47	14	11	47	30	16	47	49	2
47	78	20	47	141	30	47	185	23	47	224	28	47	461	0	47	469	0
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49	275	16	49	318	0	49	326	0	50	5	22	50	22	12	50	36	5
50	56	10	50	102	30	50	149	26	50	196	24	50	258	3	50	342	0
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51	144	4	51	198	26	51	248	17	51	366	0	51	374	0	52	23	3
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52	295	0	52	390	0	52	398	0	53	5	5	53	15	29	53	39	13
53	40	4	53	93	20	53	128	1	53	169	22	53	287	8	53	414	0
53	422	0	54	17	17	54	39	28	54	44	29	54	75	1	54	136	25
54	172	4	54	237	9	54	438	0	54	446	0	55	15	11	55	31	16
55	50	2	55	79	20	55	142	30	55	186	23	55	225	28	55	462	0
55	470	0	56	13	4	56	30	9	56	32	0	56	52	14	56	76	11
56	113	23	56	161	18	56	218	28	56	282	4	56	295	0	56	303	0
57	1	25	57	29	4	57	43	24	57	65	18	57	118	0	57	166	17
57	214	6	57	276	16	57	319	0	57	327	0	58	6	22	58	23	12
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59	103	12	59	145	4	59	199	26	59	249	17	59	367	0	59	375	0
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60	179	6	60	288	1	60	391	0	60	399	0	61	6	5	61	8	30
61	32	14	61	41	4	61	94	20	61	129	1	61	170	22	61	280	9
61	415	0	61	423	0	62	18	17	62	32	29	62	45	29	62	76	1

62	137	25	62	173	4	62	238	9	62	439	0	62	447	0	63	8	12
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63	463	0	63	471	0	64	15	14	64	24	26	64	39	24	64	65	9
64	118	0	64	162	5	64	220	8	64	277	2	64	296	0	64	304	0
65	0	5	65	25	19	65	47	23	65	62	23	65	116	22	65	165	23
65	203	9	65	286	24	65	320	0	65	328	0	66	6	24	66	8	6
66	20	0	66	39	16	66	49	20	66	88	30	66	146	20	66	217	24
66	258	21	66	344	0	66	352	0	67	6	0	67	21	13	67	47	22
67	48	10	67	81	16	67	141	2	67	186	6	67	249	1	67	368	0
67	376	0	68	15	20	68	34	12	68	50	18	68	79	22	68	152	23
68	179	7	68	243	4	68	392	0	68	400	0	69	8	12	69	34	21
69	52	16	69	82	16	69	127	8	69	183	12	69	232	10	69	416	0
69	424	0	70	19	21	70	33	7	70	50	14	70	105	15	70	130	30
70	208	3	70	270	24	70	440	0	70	448	0	71	2	21	71	15	1
71	29	20	71	49	0	71	86	28	71	126	8	71	228	1	71	241	29
71	464	0	71	472	0	72	8	15	72	25	26	72	32	25	72	66	9
72	119	0	72	163	5	72	221	8	72	278	2	72	297	0	72	305	0
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73	204	9	73	287	24	73	321	0	73	329	0	74	7	24	74	9	6
74	21	0	74	32	17	74	50	20	74	89	30	74	147	20	74	218	24
74	259	21	74	345	0	74	353	0	75	7	0	75	22	13	75	40	23
75	49	10	75	82	16	75	142	2	75	187	6	75	250	1	75	369	0
75	377	0	76	8	21	76	35	12	76	51	18	76	72	23	76	153	23
76	180	7	76	244	4	76	393	0	76	401	0	77	9	12	77	35	21
77	53	16	77	83	16	77	120	9	77	176	13	77	233	10	77	417	0
77	425	0	78	20	21	78	34	7	78	51	14	78	106	15	78	131	30
78	209	3	78	271	24	78	441	0	78	449	0	79	3	21	79	8	2
79	30	20	79	50	0	79	87	28	79	127	8	79	229	1	79	242	29
79	465	0	79	473	0	80	9	15	80	26	26	80	33	25	80	67	9
80	112	1	80	164	5	80	222	8	80	279	2	80	298	0	80	306	0
81	2	5	81	27	19	81	41	24	81	56	24	81	118	22	81	167	23
81	205	9	81	280	25	81	322	0	81	330	0	82	0	25	82	10	6
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83	50	10	83	83	16	83	143	2	83	188	6	83	251	1	83	370	0
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84	181	7	84	245	4	84	394	0	84	402	0	85	10	12	85	36	21
85	54	16	85	84	16	85	121	9	85	177	13	85	234	10	85	418	0
85	426	0	86	21	21	86	35	7	86	52	14	86	107	15	86	132	30
86	210	3	86	264	25	86	442	0	86	450	0	87	4	21	87	9	2
87	31	20	87	51	0	87	80	29	87	120	9	87	230	1	87	243	29
87	466	0	87	474	0	88	10	15	88	27	26	88	34	25	88	68	9
88	113	1	88	165	5	88	223	8	88	272	3	88	299	0	88	307	0
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89	206	9	89	281	25	89	323	0	89	331	0	90	1	25	90	11	6
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91	51	10	91	84	16	91	136	3	91	189	6	91	252	1	91	371	0
91	379	0	92	10	21	92	37	12	92	53	18	92	74	23	92	155	23
92	182	7	92	246	4	92	395	0	92	403	0	93	11	12	93	37	21
93	55	16	93	85	16	93	122	9	93	178	13	93	235	10	93	419	0
93	427	0	94	22	21	94	36	7	94	53	14	94	108	15	94	133	30
94	211	3	94	265	25	94	443	0	94	451	0	95	5	21	95	10	2

95	24	21	95	52	0	95	81	29	95	121	9	95	231	1	95	244	29
95	467	0	95	475	0	96	11	15	96	28	26	96	35	25	96	69	9
96	114	1	96	166	5	96	216	9	96	273	3	96	300	0	96	308	0
97	4	5	97	29	19	97	43	24	97	58	24	97	112	23	97	161	24
97	207	9	97	282	25	97	324	0	97	332	0	98	2	25	98	12	6
98	16	1	98	35	17	98	53	20	98	92	30	98	150	20	98	221	24
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99	52	10	99	85	16	99	137	3	99	190	6	99	253	1	99	372	0
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101	48	17	101	86	16	101	123	9	101	179	13	101	236	10	101	420	0
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103	468	0	103	476	0	104	12	15	104	29	26	104	36	25	104	70	9
104	115	1	104	167	5	104	217	9	104	274	3	104	301	0	104	309	0
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107	53	10	107	86	16	107	138	3	107	191	6	107	254	1	107	373	0
107	381	0	108	12	21	108	39	12	108	55	18	108	76	23	108	157	23
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109	49	17	109	87	16	109	124	9	109	180	13	109	237	10	109	421	0
109	429	0	110	16	22	110	38	7	110	55	14	110	110	15	110	135	30
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115	382	0	116	13	21	116	32	13	116	48	19	116	77	23	116	158	23
116	177	8	116	241	5	116	398	0	116	406	0	117	14	12	117	32	22
117	50	17	117	80	17	117	125	9	117	181	13	117	238	10	117	422	0
117	430	0	118	17	22	118	39	7	118	48	15	118	111	15	118	128	31
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125	51	17	125	81	17	125	126	9	125	182	13	125	239	10	125	423	0
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131	126	19	131	157	6	131	179	3	131	242	11	131	376	0	131	384	0
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133	41	1	133	108	6	133	150	21	133	199	22	133	255	16	133	424	0
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153	159	1	153	206	3	153	256	21	153	331	0	153	339	0	154	1	18
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155	121	20	155	152	7	155	182	3	155	245	11	155	379	0	155	387	0
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157	44	1	157	111	6	157	145	22	157	194	23	157	250	17	157	427	0
157	435	0	158	13	6	158	23	7	158	25	2	158	53	29	158	104	18
158	130	18	158	186	31	158	270	9	158	451	0	158	459	0	159	2	7
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161	60	19	161	101	6	161	152	2	161	207	3	161	257	21	161	332	0
161	340	0	162	2	18	162	21	7	162	27	19	162	40	10	162	91	1
162	175	20	162	185	15	162	279	21	162	356	0	162	364	0	163	18	11
163	25	3	163	50	15	163	122	20	163	153	7	163	183	3	163	246	11
163	380	0	163	388	0	164	8	2	164	35	14	164	52	5	164	99	7
164	141	0	164	201	29	164	239	16	164	404	0	164	412	0	165	11	5
165	21	15	165	32	12	165	45	1	165	104	7	165	146	22	165	195	23
165	251	17	165	428	0	165	436	0	166	14	6	166	16	8	166	26	2
166	54	29	166	105	18	166	131	18	166	187	31	166	271	9	166	452	0
166	460	0	167	3	7	167	8	1	167	33	31	167	40	23	167	48	30
167	84	18	167	126	6	167	172	31	167	229	26	167	294	0	167	476	0
168	5	9	168	31	28	168	42	20	168	68	9	168	110	20	168	155	19
168	214	15	168	271	31	168	309	0	168	317	0	169	2	4	169	16	31
169	29	10	169	47	25	169	61	19	169	102	6	169	153	2	169	200	4
169	258	21	169	333	0	169	341	0	170	3	18	170	22	7	170	28	19
170	41	10	170	92	1	170	168	21	170	186	15	170	272	22	170	357	0
170	365	0	171	19	11	171	26	3	171	51	15	171	123	20	171	154	7
171	176	4	171	247	11	171	381	0	171	389	0	172	9	2	172	36	14
172	53	5	172	100	7	172	142	0	172	202	29	172	232	17	172	405	0
172	413	0	173	12	5	173	22	15	173	33	12	173	46	1	173	105	7
173	147	22	173	196	23	173	252	17	173	429	0	173	437	0	174	15	6
174	17	8	174	27	2	174	55	29	174	106	18	174	132	18	174	188	31
174	264	10	174	453	0	174	461	0	175	4	7	175	9	1	175	34	31
175	41	23	175	49	30	175	85	18	175	127	6	175	173	31	175	230	26
175	295	0	175	477	0	176	6	9	176	24	29	176	43	20	176	69	9
176	111	20	176	156	19	176	215	15	176	264	0	176	310	0	176	318	0
177	3	4	177	17	31	177	30	10	177	40	26	177	62	19	177	103	6
177	154	2	177	201	4	177	259	21	177	334	0	177	342	0	178	4	18
178	23	7	178	29	19	178	42	10	178	93	1	178	169	21	178	187	15
178	273	22	178	358	0	178	366	0	179	20	11	179	27	3	179	52	15
179	124	20	179	155	7	179	177	4	179	240	12	179	382	0	179	390	0
180	10	2	180	37	14	180	54	5	180	101	7	180	143	0	180	203	29
180	233	17	180	406	0	180	414	0	181	13	5	181	23	15	181	34	12
181	47	1	181	106	7	181	148	22	181	197	23	181	253	17	181	430	0
181	438	0	182	8	7	182	18	8	182	28	2	182	48	30	182	107	18
182	133	18	182	189	31	182	265	10	182	454	0	182	462	0	183	5	7
183	10	1	183	35	31	183	42	23	183	50	30	183	86	18	183	120	7
183	174	31	183	231	26	183	288	1	183	478	0	184	7	9	184	25	29
184	44	20	184	70	9	184	104	21	184	157	19	184	208	16	184	265	0
184	311	0	184	319	0	185	4	4	185	18	31	185	31	10	185	41	26
185	63	19	185	96	7	185	155	2	185	202	4	185	260	21	185	335	0
185	343	0	186	5	18	186	16	8	186	30	19	186	43	10	186	94	1
186	170	21	186	188	15	186	274	22	186	359	0	186	367	0	187	21	11
187	28	3	187	53	15	187	125	20	187	156	7	187	178	4	187	241	12
187	383	0	187	391	0	188	11	2	188	38	14	188	55	5	188	102	7
188	136	1	188	204	29	188	234	17	188	407	0	188	415	0	189	14	5
189	16	16	189	35	12	189	40	2	189	107	7	189	149	22	189	198	23
189	254	17	189	431	0	189	439	0	190	9	7	190	19	8	190	29	2
190	49	30	190	108	18	190	134	18	190	190	31	190	266	10	190	455	0
190	463	0	191	6	7	191	11	1	191	36	31	191	43	23	191	51	30

191 87 18 191 121 7 191 175 31 191 224 27 191 289 1 191 479 0

Appendix Table E: Specification of the base matrix $B_{\frac{2}{3}}$ for the rate-2/3 LDPC code

0	6	31	0	13	26	0	38	22	0	43	5	0	74	9	0	83	4
0	120	16	0	162	5	0	211	28	0	259	16	0	314	3	0	320	0
0	328	0	1	0	23	1	8	27	1	31	7	1	47	5	1	78	19
1	119	17	1	154	29	1	202	14	1	240	19	1	297	2	1	340	0
1	348	0	2	0	4	2	9	15	2	30	12	2	46	31	2	66	22
2	117	2	2	170	15	2	192	29	2	258	28	2	291	27	2	360	0
2	368	0	3	5	2	3	11	7	3	28	18	3	34	5	3	94	28
3	106	2	3	156	23	3	197	21	3	265	1	3	305	5	3	380	0
3	388	0	4	23	16	4	28	19	4	35	5	4	54	11	4	86	18
4	101	23	4	148	7	4	181	3	4	237	26	4	321	0	4	400	0
4	408	0	5	0	17	5	17	28	5	26	27	5	37	29	5	61	0
5	128	30	5	150	1	5	177	0	5	223	0	5	316	8	5	420	0
5	428	0	6	8	17	6	16	3	6	41	15	6	55	3	6	129	20
6	163	28	6	206	12	6	248	14	6	302	4	6	440	0	6	448	0
7	14	19	7	22	30	7	35	19	7	60	15	7	94	9	7	179	11
7	184	14	7	237	2	7	286	11	7	460	0	7	468	0	8	7	31
8	14	26	8	39	22	8	44	5	8	75	9	8	84	4	8	121	16
8	163	5	8	212	28	8	260	16	8	315	3	8	321	0	8	329	0
9	1	23	9	9	27	9	24	8	9	40	6	9	79	19	9	112	18
9	155	29	9	203	14	9	241	19	9	298	2	9	341	0	9	349	0
10	1	4	10	10	15	10	31	12	10	47	31	10	67	22	10	118	2
10	171	15	10	193	29	10	259	28	10	292	27	10	361	0	10	369	0
11	6	2	11	12	7	11	29	18	11	35	5	11	95	28	11	107	2
11	157	23	11	198	21	11	266	1	11	306	5	11	381	0	11	389	0
12	16	17	12	29	19	12	36	5	12	55	11	12	87	18	12	102	23
12	149	7	12	182	3	12	238	26	12	322	0	12	401	0	12	409	0
13	1	17	13	18	28	13	27	27	13	38	29	13	62	0	13	129	30
13	151	1	13	178	0	13	216	1	13	317	8	13	421	0	13	429	0
14	9	17	14	17	3	14	42	15	14	48	4	14	130	20	14	164	28
14	207	12	14	249	14	14	303	4	14	441	0	14	449	0	15	15	19
15	23	30	15	36	19	15	61	15	15	95	9	15	180	11	15	185	14
15	238	2	15	287	11	15	461	0	15	469	0	16	0	0	16	15	26
16	32	23	16	45	5	16	76	9	16	85	4	16	122	16	16	164	5
16	213	28	16	261	16	16	316	3	16	322	0	16	330	0	17	2	23
17	10	27	17	25	8	17	41	6	17	72	20	17	113	18	17	156	29
17	204	14	17	242	19	17	299	2	17	342	0	17	350	0	18	2	4
18	11	15	18	24	13	18	40	0	18	68	22	18	119	2	18	172	15
18	194	29	18	260	28	18	293	27	18	362	0	18	370	0	19	7	2
19	13	7	19	30	18	19	36	5	19	88	29	19	108	2	19	158	23
19	199	21	19	267	1	19	307	5	19	382	0	19	390	0	20	17	17
20	30	19	20	37	5	20	48	12	20	80	19	20	103	23	20	150	7
20	183	3	20	239	26	20	323	0	20	402	0	20	410	0	21	2	17
21	19	28	21	28	27	21	39	29	21	63	0	21	130	30	21	144	2
21	179	0	21	217	1	21	318	8	21	422	0	21	430	0	22	10	17
22	18	3	22	43	15	22	49	4	22	131	20	22	165	28	22	200	13
22	250	14	22	296	5	22	442	0	22	450	0	23	8	20	23	16	31
23	37	19	23	62	15	23	88	10	23	181	11	23	186	14	23	239	2
23	280	12	23	462	0	23	470	0	24	1	0	24	8	27	24	33	23
24	46	5	24	77	9	24	86	4	24	123	16	24	165	5	24	214	28
24	262	16	24	317	3	24	323	0	24	331	0	25	3	23	25	11	27

25	26	8	25	42	6	25	73	20	25	114	18	25	157	29	25	205	14
25	243	19	25	300	2	25	343	0	25	351	0	26	3	4	26	12	15
26	25	13	26	41	0	26	69	22	26	112	3	26	173	15	26	195	29
26	261	28	26	294	27	26	363	0	26	371	0	27	0	3	27	14	7
27	31	18	27	37	5	27	89	29	27	109	2	27	159	23	27	192	22
27	268	1	27	308	5	27	383	0	27	391	0	28	18	17	28	31	19
28	38	5	28	49	12	28	81	19	28	96	24	28	151	7	28	176	4
28	232	27	28	324	0	28	403	0	28	411	0	29	3	17	29	20	28
29	29	27	29	32	30	29	56	1	29	131	30	29	145	2	29	180	0
29	218	1	29	319	8	29	423	0	29	431	0	30	11	17	30	19	3
30	44	15	30	50	4	30	132	20	30	166	28	30	201	13	30	251	14
30	297	5	30	443	0	30	451	0	31	9	20	31	17	31	31	38	19
31	63	15	31	89	10	31	182	11	31	187	14	31	232	3	31	281	12
31	463	0	31	471	0	32	2	0	32	9	27	32	34	23	32	47	5
32	78	9	32	87	4	32	124	16	32	166	5	32	215	28	32	263	16
32	318	3	32	324	0	32	332	0	33	1	5	33	14	30	33	29	21
33	47	1	33	76	15	33	127	23	33	154	7	33	192	3	33	246	23
33	317	24	33	344	0	33	352	0	34	4	4	34	13	15	34	26	13
34	42	0	34	70	22	34	113	3	34	174	15	34	196	29	34	262	28
34	295	27	34	364	0	34	372	0	35	4	21	35	11	18	35	17	7
35	33	30	35	74	4	35	126	29	35	153	28	35	189	30	35	242	1
35	282	31	35	384	0	35	392	0	36	19	17	36	24	20	36	39	5
36	50	12	36	82	19	36	97	24	36	144	8	36	177	4	36	233	27
36	325	0	36	404	0	36	412	0	37	21	0	37	26	6	37	33	9
37	54	14	37	91	30	37	143	15	37	175	18	37	253	10	37	273	8
37	424	0	37	432	0	38	12	17	38	20	3	38	45	15	38	51	4
38	133	20	38	167	28	38	202	13	38	252	14	38	298	5	38	444	0
38	452	0	39	19	0	39	32	25	39	40	29	39	65	11	39	80	27
39	130	5	39	175	11	39	229	3	39	274	31	39	464	0	39	472	0
40	3	0	40	10	27	40	35	23	40	40	6	40	79	9	40	80	5
40	125	16	40	167	5	40	208	29	40	256	17	40	319	3	40	325	0
40	333	0	41	2	5	41	15	30	41	30	21	41	40	2	41	77	15
41	120	24	41	155	7	41	193	3	41	247	23	41	318	24	41	345	0
41	353	0	42	5	4	42	14	15	42	27	13	42	43	0	42	71	22
42	114	3	42	175	15	42	197	29	42	263	28	42	288	28	42	365	0
42	373	0	43	5	21	43	12	18	43	18	7	43	34	30	43	75	4
43	127	29	43	154	28	43	190	30	43	243	1	43	283	31	43	385	0
43	393	0	44	20	17	44	25	20	44	32	6	44	51	12	44	83	19
44	98	24	44	145	8	44	178	4	44	234	27	44	326	0	44	405	0
44	413	0	45	22	0	45	27	6	45	34	9	45	55	14	45	92	30
45	136	16	45	168	19	45	254	10	45	274	8	45	425	0	45	433	0
46	13	17	46	21	3	46	46	15	46	52	4	46	134	20	46	160	29
46	203	13	46	253	14	46	299	5	46	445	0	46	453	0	47	20	0
47	33	25	47	41	29	47	66	11	47	81	27	47	131	5	47	168	12
47	230	3	47	275	31	47	465	0	47	473	0	48	4	0	48	11	27
48	36	23	48	41	6	48	72	10	48	81	5	48	126	16	48	160	6
48	209	29	48	257	17	48	312	4	48	326	0	48	334	0	49	3	5
49	8	31	49	31	21	49	41	2	49	78	15	49	121	24	49	156	7
49	194	3	49	240	24	49	319	24	49	346	0	49	354	0	50	6	4
50	15	15	50	28	13	50	44	0	50	64	23	50	115	3	50	168	16
50	198	29	50	256	29	50	289	28	50	366	0	50	374	0	51	6	21
51	13	18	51	19	7	51	35	30	51	76	4	51	120	30	51	155	28
51	191	30	51	244	1	51	284	31	51	386	0	51	394	0	52	21	17

52	26	20	52	33	6	52	52	12	52	84	19	52	99	24	52	146	8
52	179	4	52	235	27	52	327	0	52	406	0	52	414	0	53	23	0
53	28	6	53	35	9	53	48	15	53	93	30	53	137	16	53	169	19
53	255	10	53	275	8	53	426	0	53	434	0	54	14	17	54	22	3
54	47	15	54	53	4	54	135	20	54	161	29	54	204	13	54	254	14
54	300	5	54	446	0	54	454	0	55	21	0	55	34	25	55	42	29
55	67	11	55	82	27	55	132	5	55	169	12	55	231	3	55	276	31
55	466	0	55	474	0	56	5	0	56	12	27	56	37	23	56	42	6
56	73	10	56	82	5	56	127	16	56	161	6	56	210	29	56	258	17
56	313	4	56	327	0	56	335	0	57	4	5	57	9	31	57	24	22
57	42	2	57	79	15	57	122	24	57	157	7	57	195	3	57	241	24
57	312	25	57	347	0	57	355	0	58	7	4	58	8	16	58	29	13
58	45	0	58	65	23	58	116	3	58	169	16	58	199	29	58	257	29
58	290	28	58	367	0	58	375	0	59	7	21	59	14	18	59	20	7
59	36	30	59	77	4	59	121	30	59	156	28	59	184	31	59	245	1
59	285	31	59	387	0	59	395	0	60	22	17	60	27	20	60	34	6
60	53	12	60	85	19	60	100	24	60	147	8	60	180	4	60	236	27
60	320	1	60	407	0	60	415	0	61	16	1	61	29	6	61	36	9
61	49	15	61	94	30	61	138	16	61	170	19	61	248	11	61	276	8
61	427	0	61	435	0	62	15	17	62	23	3	62	40	16	62	54	4
62	128	21	62	162	29	62	205	13	62	255	14	62	301	5	62	447	0
62	455	0	63	22	0	63	35	25	63	43	29	63	68	11	63	83	27
63	133	5	63	170	12	63	224	4	63	277	31	63	467	0	63	475	0
64	3	21	64	11	21	64	25	23	64	41	11	64	101	13	64	121	2
64	162	2	64	201	27	64	253	24	64	311	17	64	328	0	64	336	0
65	5	5	65	10	31	65	25	22	65	43	2	65	72	16	65	123	24
65	158	7	65	196	3	65	242	24	65	313	25	65	348	0	65	356	0
66	11	28	66	26	2	66	32	29	66	45	19	66	92	11	66	111	2
66	141	31	66	196	11	66	259	5	66	288	17	66	368	0	66	376	0
67	0	22	67	15	18	67	21	7	67	37	30	67	78	4	67	122	30
67	157	28	67	185	31	67	246	1	67	286	31	67	388	0	67	396	0
68	2	11	68	18	23	68	25	14	68	38	18	68	52	15	68	103	2
68	151	27	68	182	13	68	269	11	68	309	9	68	408	0	68	416	0
69	17	1	69	30	6	69	37	9	69	50	15	69	95	30	69	139	16
69	171	19	69	249	11	69	277	8	69	428	0	69	436	0	70	13	1
70	19	1	70	43	9	70	62	5	70	108	8	70	133	24	70	169	3
70	216	19	70	301	4	70	448	0	70	456	0	71	23	0	71	36	25
71	44	29	71	69	11	71	84	27	71	134	5	71	171	12	71	225	4
71	278	31	71	468	0	71	476	0	72	4	21	72	12	21	72	26	23
72	42	11	72	102	13	72	122	2	72	163	2	72	202	27	72	254	24
72	304	18	72	329	0	72	337	0	73	6	5	73	11	31	73	26	22
73	44	2	73	73	16	73	124	24	73	159	7	73	197	3	73	243	24
73	314	25	73	349	0	73	357	0	74	12	28	74	27	2	74	33	29
74	46	19	74	93	11	74	104	3	74	142	31	74	197	11	74	260	5
74	289	17	74	369	0	74	377	0	75	1	22	75	8	19	75	22	7
75	38	30	75	79	4	75	123	30	75	158	28	75	186	31	75	247	1
75	287	31	75	389	0	75	397	0	76	3	11	76	19	23	76	26	14
76	39	18	76	53	15	76	96	3	76	144	28	76	183	13	76	270	11
76	310	9	76	409	0	76	417	0	77	18	1	77	31	6	77	38	9
77	51	15	77	88	31	77	140	16	77	172	19	77	250	11	77	278	8
77	429	0	77	437	0	78	14	1	78	20	1	78	44	9	78	63	5
78	109	8	78	134	24	78	170	3	78	217	19	78	302	4	78	449	0
78	457	0	79	16	1	79	37	25	79	45	29	79	70	11	79	85	27

79	135	5	79	172	12	79	226	4	79	279	31	79	469	0	79	477	0
80	5	21	80	13	21	80	27	23	80	43	11	80	103	13	80	123	2
80	164	2	80	203	27	80	255	24	80	305	18	80	330	0	80	338	0
81	7	5	81	12	31	81	27	22	81	45	2	81	74	16	81	125	24
81	152	8	81	198	3	81	244	24	81	315	25	81	350	0	81	358	0
82	13	28	82	28	2	82	34	29	82	47	19	82	94	11	82	105	3
82	143	31	82	198	11	82	261	5	82	290	17	82	370	0	82	378	0
83	2	22	83	9	19	83	23	7	83	39	30	83	72	5	83	124	30
83	159	28	83	187	31	83	240	2	83	280	0	83	390	0	83	398	0
84	4	11	84	20	23	84	27	14	84	32	19	84	54	15	84	97	3
84	145	28	84	176	14	84	271	11	84	311	9	84	410	0	84	418	0
85	19	1	85	24	7	85	39	9	85	52	15	85	89	31	85	141	16
85	173	19	85	251	11	85	279	8	85	430	0	85	438	0	86	15	1
86	21	1	86	45	9	86	56	6	86	110	8	86	135	24	86	171	3
86	218	19	86	303	4	86	450	0	86	458	0	87	17	1	87	38	25
87	46	29	87	71	11	87	86	27	87	128	6	87	173	12	87	227	4
87	272	0	87	470	0	87	478	0	88	6	21	88	14	21	88	28	23
88	44	11	88	96	14	88	124	2	88	165	2	88	204	27	88	248	25
88	306	18	88	331	0	88	339	0	89	0	6	89	13	31	89	28	22
89	46	2	89	75	16	89	126	24	89	153	8	89	199	3	89	245	24
89	316	25	89	351	0	89	359	0	90	14	28	90	29	2	90	35	29
90	40	20	90	95	11	90	106	3	90	136	0	90	199	11	90	262	5
90	291	17	90	371	0	90	379	0	91	3	22	91	10	19	91	16	8
91	32	31	91	73	5	91	125	30	91	152	29	91	188	31	91	241	2
91	281	0	91	391	0	91	399	0	92	5	11	92	21	23	92	28	14
92	33	19	92	55	15	92	98	3	92	146	28	92	177	14	92	264	12
92	304	10	92	411	0	92	419	0	93	20	1	93	25	7	93	32	10
93	53	15	93	90	31	93	142	16	93	174	19	93	252	11	93	272	9
93	431	0	93	439	0	94	8	2	94	22	1	94	46	9	94	57	6
94	111	8	94	128	25	94	172	3	94	219	19	94	296	5	94	451	0
94	459	0	95	18	1	95	39	25	95	47	29	95	64	12	95	87	27
95	129	6	95	174	12	95	228	4	95	273	0	95	471	0	95	479	0
96	7	21	96	15	21	96	29	23	96	45	11	96	97	14	96	125	2
96	166	2	96	205	27	96	249	25	96	307	18	96	332	0	96	340	0
97	6	8	97	10	24	97	30	23	97	41	11	97	85	3	97	114	23
97	149	25	97	212	10	97	232	24	97	295	9	97	352	0	97	360	0
98	15	28	98	30	2	98	36	29	98	41	20	98	88	12	98	107	3
98	137	0	98	192	12	98	263	5	98	292	17	98	372	0	98	380	0
99	6	29	99	17	8	99	26	19	99	38	1	99	61	28	99	117	26
99	140	23	99	187	15	99	224	15	99	286	17	99	392	0	99	400	0
100	6	11	100	22	23	100	29	14	100	34	19	100	48	16	100	99	3
100	147	28	100	178	14	100	265	12	100	305	10	100	412	0	100	420	0
101	19	11	101	35	29	101	43	8	101	66	20	101	100	1	101	165	3
101	208	13	101	224	25	101	277	2	101	432	0	101	440	0	102	9	2
102	23	1	102	47	9	102	58	6	102	104	9	102	129	25	102	173	3
102	220	19	102	297	5	102	452	0	102	460	0	103	6	4	103	18	4
103	46	23	103	64	7	103	107	13	103	143	0	103	187	30	103	223	18
103	268	25	103	322	0	103	472	0	104	0	22	104	8	22	104	30	23
104	46	11	104	98	14	104	126	2	104	167	2	104	206	27	104	250	25
104	308	18	104	333	0	104	341	0	105	7	8	105	11	24	105	31	23
105	42	11	105	86	3	105	115	23	105	150	25	105	213	10	105	233	24
105	288	10	105	353	0	105	361	0	106	8	29	106	31	2	106	37	29
106	42	20	106	89	12	106	108	3	106	138	0	106	193	12	106	256	6

106	293	17	106	373	0	106	381	0	107	7	29	107	18	8	107	27	19
107	39	1	107	62	28	107	118	26	107	141	23	107	188	15	107	225	15
107	287	17	107	393	0	107	401	0	108	7	11	108	23	23	108	30	14
108	35	19	108	49	16	108	100	3	108	148	28	108	179	14	108	266	12
108	306	10	108	413	0	108	421	0	109	20	11	109	36	29	109	44	8
109	67	20	109	101	1	109	166	3	109	209	13	109	225	25	109	278	2
109	433	0	109	441	0	110	10	2	110	16	2	110	40	10	110	59	6
110	105	9	110	130	25	110	174	3	110	221	19	110	298	5	110	453	0
110	461	0	111	7	4	111	19	4	111	47	23	111	65	7	111	108	13
111	136	1	111	188	30	111	216	19	111	269	25	111	323	0	111	473	0
112	1	22	112	9	22	112	31	23	112	47	11	112	99	14	112	127	2
112	160	3	112	207	27	112	251	25	112	309	18	112	334	0	112	342	0
113	0	9	113	12	24	113	24	24	113	43	11	113	87	3	113	116	23
113	151	25	113	214	10	113	234	24	113	289	10	113	354	0	113	362	0
114	9	29	114	24	3	114	38	29	114	43	20	114	90	12	114	109	3
114	139	0	114	194	12	114	257	6	114	294	17	114	374	0	114	382	0
115	0	30	115	19	8	115	28	19	115	32	2	115	63	28	115	119	26
115	142	23	115	189	15	115	226	15	115	280	18	115	394	0	115	402	0
116	0	12	116	16	24	116	31	14	116	36	19	116	50	16	116	101	3
116	149	28	116	180	14	116	267	12	116	307	10	116	414	0	116	422	0
117	21	11	117	37	29	117	45	8	117	68	20	117	102	1	117	167	3
117	210	13	117	226	25	117	279	2	117	434	0	117	442	0	118	11	2
118	17	2	118	41	10	118	60	6	118	106	9	118	131	25	118	175	3
118	222	19	118	299	5	118	454	0	118	462	0	119	0	5	119	20	4
119	40	24	119	66	7	119	109	13	119	137	1	119	189	30	119	217	19
119	270	25	119	324	0	119	474	0	120	2	22	120	10	22	120	24	24
120	40	12	120	100	14	120	120	3	120	161	3	120	200	28	120	252	25
120	310	18	120	335	0	120	343	0	121	1	9	121	13	24	121	25	24
121	44	11	121	80	4	121	117	23	121	144	26	121	215	10	121	235	24
121	290	10	121	355	0	121	363	0	122	10	29	122	25	3	122	39	29
122	44	20	122	91	12	122	110	3	122	140	0	122	195	12	122	258	6
122	295	17	122	375	0	122	383	0	123	1	30	123	20	8	123	29	19
123	33	2	123	56	29	123	112	27	123	143	23	123	190	15	123	227	15
123	281	18	123	395	0	123	403	0	124	1	12	124	17	24	124	24	15
124	37	19	124	51	16	124	102	3	124	150	28	124	181	14	124	268	12
124	308	10	124	415	0	124	423	0	125	22	11	125	38	29	125	46	8
125	69	20	125	103	1	125	160	4	125	211	13	125	227	25	125	272	3
125	435	0	125	443	0	126	12	2	126	18	2	126	42	10	126	61	6
126	107	9	126	132	25	126	168	4	126	223	19	126	300	5	126	455	0
126	463	0	127	1	5	127	21	4	127	41	24	127	67	7	127	110	13
127	138	1	127	190	30	127	218	19	127	271	25	127	325	0	127	475	0
128	4	22	128	12	26	128	27	7	128	43	5	128	74	19	128	115	17
128	158	28	128	206	13	128	244	18	128	301	1	128	336	0	128	344	0
129	2	9	129	14	24	129	26	24	129	45	11	129	81	4	129	118	23
129	145	26	129	208	11	129	236	24	129	291	10	129	356	0	129	364	0
130	1	2	130	15	6	130	24	18	130	38	4	130	90	28	130	110	1
130	152	23	130	193	21	130	269	0	130	309	4	130	376	0	130	384	0
131	2	30	131	21	8	131	30	19	131	34	2	131	57	29	131	113	27
131	136	24	131	191	15	131	228	15	131	282	18	131	396	0	131	404	0
132	4	16	132	21	27	132	30	26	132	33	29	132	57	0	132	132	29
132	146	1	132	181	31	132	219	0	132	312	8	132	416	0	132	424	0
133	23	11	133	39	29	133	47	8	133	70	20	133	96	2	133	161	4
133	212	13	133	228	25	133	273	3	133	436	0	133	444	0	134	10	19

134	18	30	134	39	18	134	56	15	134	90	9	134	183	10	134	188	13
134	233	2	134	282	11	134	456	0	134	464	0	135	2	5	135	22	4
135	42	24	135	68	7	135	111	13	135	139	1	135	191	30	135	219	19
135	264	26	135	326	0	135	476	0	136	5	22	136	13	26	136	28	7
136	44	5	136	75	19	136	116	17	136	159	28	136	207	13	136	245	18
136	302	1	136	337	0	136	345	0	137	3	9	137	15	24	137	27	24
137	46	11	137	82	4	137	119	23	137	146	26	137	209	11	137	237	24
137	292	10	137	357	0	137	365	0	138	2	2	138	8	7	138	25	18
138	39	4	138	91	28	138	111	1	138	153	23	138	194	21	138	270	0
138	310	4	138	377	0	138	385	0	139	3	30	139	22	8	139	31	19
139	35	2	139	58	29	139	114	27	139	137	24	139	184	16	139	229	15
139	283	18	139	397	0	139	405	0	140	5	16	140	22	27	140	31	26
140	34	29	140	58	0	140	133	29	140	147	1	140	182	31	140	220	0
140	313	8	140	417	0	140	425	0	141	16	12	141	32	30	141	40	9
141	71	20	141	97	2	141	162	4	141	213	13	141	229	25	141	274	3
141	437	0	141	445	0	142	11	19	142	19	30	142	32	19	142	57	15
142	91	9	142	176	11	142	189	13	142	234	2	142	283	11	142	457	0
142	465	0	143	3	5	143	23	4	143	43	24	143	69	7	143	104	14
143	140	1	143	184	31	143	220	19	143	265	26	143	327	0	143	477	0
144	6	22	144	14	26	144	29	7	144	45	5	144	76	19	144	117	17
144	152	29	144	200	14	144	246	18	144	303	1	144	338	0	144	346	0
145	4	9	145	8	25	145	28	24	145	47	11	145	83	4	145	112	24
145	147	26	145	210	11	145	238	24	145	293	10	145	358	0	145	366	0
146	3	2	146	9	7	146	26	18	146	32	5	146	92	28	146	104	2
146	154	23	146	195	21	146	271	0	146	311	4	146	378	0	146	386	0
147	4	30	147	23	8	147	24	20	147	36	2	147	59	29	147	115	27
147	138	24	147	185	16	147	230	15	147	284	18	147	398	0	147	406	0
148	6	16	148	23	27	148	24	27	148	35	29	148	59	0	148	134	29
148	148	1	148	183	31	148	221	0	148	314	8	148	418	0	148	426	0
149	17	12	149	33	30	149	41	9	149	64	21	149	98	2	149	163	4
149	214	13	149	230	25	149	275	3	149	438	0	149	446	0	150	12	19
150	20	30	150	33	19	150	58	15	150	92	9	150	177	11	150	190	13
150	235	2	150	284	11	150	458	0	150	466	0	151	4	5	151	16	5
151	44	24	151	70	7	151	105	14	151	141	1	151	185	31	151	221	19
151	266	26	151	320	1	151	478	0	152	7	22	152	15	26	152	30	7
152	46	5	152	77	19	152	118	17	152	153	29	152	201	14	152	247	18
152	296	2	152	339	0	152	347	0	153	5	9	153	9	25	153	29	24
153	40	12	153	84	4	153	113	24	153	148	26	153	211	11	153	239	24
153	294	10	153	359	0	153	367	0	154	4	2	154	10	7	154	27	18
154	33	5	154	93	28	154	105	2	154	155	23	154	196	21	154	264	1
154	304	5	154	379	0	154	387	0	155	5	30	155	16	9	155	25	20
155	37	2	155	60	29	155	116	27	155	139	24	155	186	16	155	231	15
155	285	18	155	399	0	155	407	0	156	7	16	156	16	28	156	25	27
156	36	29	156	60	0	156	135	29	156	149	1	156	176	0	156	222	0
156	315	8	156	419	0	156	427	0	157	18	12	157	34	30	157	42	9
157	65	21	157	99	2	157	164	4	157	215	13	157	231	25	157	276	3
157	439	0	157	447	0	158	13	19	158	21	30	158	34	19	158	59	15
158	93	9	158	178	11	158	191	13	158	236	2	158	285	11	158	459	0
158	467	0	159	5	5	159	17	5	159	45	24	159	71	7	159	106	14
159	142	1	159	186	31	159	222	19	159	267	26	159	321	1	159	479	0

Appendix Table F: Specification of the base matrix $B_{\frac{3}{4}}$ for the rate-3/4 LDPC code

0	3	8	0	12	23	0	16	6	0	27	5	0	36	19	0	48	3
0	84	19	0	114	9	0	143	27	0	179	21	0	206	10	0	238	0
0	274	21	0	314	3	0	353	18	0	360	0	0	368	0	1	1	14
1	12	12	1	23	26	1	37	6	1	70	14	1	84	6	1	105	23
1	143	25	1	174	0	1	204	22	1	233	2	1	268	2	1	307	4
1	345	15	1	375	0	1	383	0	2	2	4	2	12	10	2	22	21
2	35	19	2	48	15	2	84	7	2	118	4	2	134	28	2	170	13
2	189	13	2	231	4	2	272	2	2	308	4	2	337	2	2	390	0
2	398	0	3	8	3	3	20	22	3	26	5	3	42	0	3	86	10
3	107	7	3	139	4	3	167	31	3	205	2	3	234	26	3	298	5
3	311	12	3	337	1	3	405	0	3	413	0	4	7	25	4	13	1
4	22	8	4	25	10	4	41	2	4	78	11	4	99	3	4	147	1
4	156	28	4	201	27	4	243	14	4	249	11	4	315	15	4	365	0
4	420	0	4	428	0	5	4	27	5	12	27	5	21	30	5	30	28
5	36	11	5	66	3	5	107	10	5	127	8	5	150	26	5	185	19
5	221	4	5	268	1	5	285	7	5	328	4	5	435	0	5	443	0
6	1	24	6	9	22	6	29	20	6	33	3	6	60	29	6	89	29
6	132	10	6	148	13	6	192	21	6	209	31	6	240	28	6	288	25
6	334	2	6	450	0	6	458	0	7	2	10	7	26	27	7	39	7
7	41	26	7	63	2	7	91	21	7	123	22	7	158	9	7	185	3
7	208	7	7	244	2	7	272	0	7	321	25	7	465	0	7	473	0
8	4	8	8	13	23	8	17	6	8	28	5	8	37	19	8	49	3
8	85	19	8	115	9	8	136	28	8	180	21	8	207	10	8	239	0
8	275	21	8	315	3	8	354	18	8	361	0	8	369	0	9	4	20
9	8	11	9	21	22	9	34	0	9	53	0	9	75	16	9	109	20
9	136	22	9	175	4	9	199	11	9	231	14	9	256	22	9	302	27
9	356	7	9	376	0	9	384	0	10	3	4	10	13	10	10	23	21
10	36	19	10	49	15	10	85	7	10	119	4	10	135	28	10	171	13
10	190	13	10	224	5	10	273	2	10	309	4	10	338	2	10	391	0
10	399	0	11	9	3	11	21	22	11	27	5	11	43	0	11	87	10
11	108	7	11	140	4	11	160	0	11	206	2	11	235	26	11	299	5
11	304	13	11	338	1	11	406	0	11	414	0	12	0	26	12	14	1
12	23	8	12	26	10	12	42	2	12	79	11	12	100	3	12	148	1
12	157	28	12	202	27	12	244	14	12	250	11	12	316	15	12	366	0
12	421	0	12	429	0	13	5	27	13	13	27	13	22	30	13	31	28
13	37	11	13	67	3	13	108	10	13	120	9	13	151	26	13	186	19
13	222	4	13	269	1	13	286	7	13	329	4	13	436	0	13	444	0
14	2	24	14	10	22	14	30	20	14	34	3	14	61	29	14	90	29
14	133	10	14	149	13	14	193	21	14	210	31	14	241	28	14	289	25
14	335	2	14	451	0	14	459	0	15	3	10	15	27	27	15	32	8
15	42	26	15	56	3	15	92	21	15	124	22	15	159	9	15	186	3
15	209	7	15	245	2	15	273	0	15	322	25	15	466	0	15	474	0
16	5	8	16	14	23	16	18	6	16	29	5	16	38	19	16	50	3
16	86	19	16	116	9	16	137	28	16	181	21	16	200	11	16	232	1
16	276	21	16	316	3	16	355	18	16	362	0	16	370	0	17	5	20
17	9	11	17	22	22	17	35	0	17	54	0	17	76	16	17	110	20
17	137	22	17	168	5	17	192	12	17	224	15	17	257	22	17	303	27
17	357	7	17	377	0	17	385	0	18	10	13	18	17	15	18	29	19
18	36	7	18	48	2	18	79	11	18	112	2	18	133	11	18	161	17
18	195	26	18	231	27	18	260	2	18	296	11	18	336	6	18	392	0
18	400	0	19	10	3	19	22	22	19	28	5	19	44	0	19	80	11

19	109	7	19	141	4	19	161	0	19	207	2	19	236	26	19	300	5
19	305	13	19	339	1	19	407	0	19	415	0	20	1	26	20	15	1
20	16	9	20	27	10	20	43	2	20	72	12	20	101	3	20	149	1
20	158	28	20	203	27	20	245	14	20	251	11	20	317	15	20	367	0
20	422	0	20	430	0	21	6	27	21	14	27	21	23	30	21	24	29
21	38	11	21	68	3	21	109	10	21	121	9	21	144	27	21	187	19
21	223	4	21	270	1	21	287	7	21	330	4	21	437	0	21	445	0
22	3	24	22	11	22	22	31	20	22	35	3	22	62	29	22	91	29
22	134	10	22	150	13	22	194	21	22	211	31	22	242	28	22	290	25
22	328	3	22	452	0	22	460	0	23	4	10	23	28	27	23	33	8
23	43	26	23	57	3	23	93	21	23	125	22	23	152	10	23	187	3
23	210	7	23	246	2	23	274	0	23	323	25	23	467	0	23	475	0
24	6	8	24	15	23	24	19	6	24	30	5	24	39	19	24	51	3
24	87	19	24	117	9	24	138	28	24	182	21	24	201	11	24	233	1
24	277	21	24	317	3	24	356	18	24	363	0	24	371	0	25	6	20
25	10	11	25	23	22	25	36	0	25	55	0	25	77	16	25	111	20
25	138	22	25	169	5	25	193	12	25	225	15	25	258	22	25	296	28
25	358	7	25	378	0	25	386	0	26	11	13	26	18	15	26	30	19
26	37	7	26	49	2	26	72	12	26	113	2	26	134	11	26	162	17
26	196	26	26	224	28	26	261	2	26	297	11	26	337	6	26	393	0
26	401	0	27	7	13	27	8	9	27	23	3	27	24	0	27	44	26
27	78	0	27	96	10	27	129	1	27	163	31	27	196	0	27	219	9
27	256	21	27	289	20	27	331	24	27	408	0	27	416	0	28	2	26
28	8	2	28	17	9	28	28	10	28	44	2	28	73	12	28	102	3
28	150	1	28	159	28	28	204	27	28	246	14	28	252	11	28	318	15
28	360	1	28	423	0	28	431	0	29	7	27	29	15	27	29	16	31
29	25	29	29	39	11	29	69	3	29	110	10	29	122	9	29	145	27
29	188	19	29	216	5	29	271	1	29	280	8	29	331	4	29	438	0
29	446	0	30	4	24	30	12	22	30	24	21	30	36	3	30	63	29
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30	291	25	30	329	3	30	453	0	30	461	0	31	5	10	31	29	27
31	34	8	31	44	26	31	58	3	31	94	21	31	126	22	31	153	10
31	188	3	31	211	7	31	247	2	31	275	0	31	324	25	31	468	0
31	476	0	32	7	8	32	8	24	32	20	6	32	31	5	32	32	20
32	52	3	32	80	20	32	118	9	32	139	28	32	183	21	32	202	11
32	234	1	32	278	21	32	318	3	32	357	18	32	364	0	32	372	0
33	7	20	33	11	11	33	16	23	33	37	0	33	48	1	33	78	16
33	104	21	33	139	22	33	170	5	33	194	12	33	226	15	33	259	22
33	297	28	33	359	7	33	379	0	33	387	0	34	12	13	34	19	15
34	31	19	34	38	7	34	50	2	34	73	12	34	114	2	34	135	11
34	163	17	34	197	26	34	225	28	34	262	2	34	298	11	34	338	6
34	394	0	34	402	0	35	0	14	35	9	9	35	16	4	35	25	0
35	45	26	35	79	0	35	97	10	35	130	1	35	164	31	35	197	0
35	220	9	35	257	21	35	290	20	35	332	24	35	409	0	35	417	0
36	13	21	36	22	26	36	26	7	36	35	11	36	65	22	36	103	12
36	147	14	36	173	30	36	185	6	36	216	18	36	269	10	36	280	26
36	345	15	36	424	0	36	432	0	37	0	28	37	8	28	37	17	31
37	26	29	37	32	12	37	70	3	37	111	10	37	123	9	37	146	27
37	189	19	37	217	5	37	264	2	37	281	8	37	332	4	37	439	0
37	447	0	38	5	24	38	13	22	38	25	21	38	37	3	38	56	30
38	93	29	38	128	11	38	144	14	38	196	21	38	213	31	38	244	28
38	292	25	38	330	3	38	454	0	38	462	0	39	6	10	39	30	27
39	35	8	39	45	26	39	59	3	39	95	21	39	127	22	39	154	10

39	189	3	39	212	7	39	240	3	39	276	0	39	325	25	39	469	0
39	477	0	40	0	9	40	9	24	40	21	6	40	24	6	40	33	20
40	53	3	40	81	20	40	119	9	40	140	28	40	176	22	40	203	11
40	235	1	40	279	21	40	319	3	40	358	18	40	365	0	40	373	0
41	0	21	41	12	11	41	17	23	41	38	0	41	49	1	41	79	16
41	105	21	41	140	22	41	171	5	41	195	12	41	227	15	41	260	22
41	298	28	41	352	8	41	380	0	41	388	0	42	13	13	42	20	15
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42	164	17	42	198	26	42	226	28	42	263	2	42	299	11	42	339	6
42	395	0	42	403	0	43	1	14	43	10	9	43	17	4	43	26	0
43	46	26	43	72	1	43	98	10	43	131	1	43	165	31	43	198	0
43	221	9	43	258	21	43	291	20	43	333	24	43	410	0	43	418	0
44	14	21	44	23	26	44	27	7	44	36	11	44	66	22	44	96	13
44	148	14	44	174	30	44	186	6	44	217	18	44	270	10	44	281	26
44	346	15	44	425	0	44	433	0	45	3	20	45	19	19	45	30	15
45	37	9	45	69	0	45	102	28	45	121	2	45	161	7	45	179	2
45	212	19	45	251	5	45	327	18	45	353	9	45	440	0	45	448	0
46	6	24	46	14	22	46	26	21	46	38	3	46	57	30	46	94	29
46	129	11	46	145	14	46	197	21	46	214	31	46	245	28	46	293	25
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47	46	26	47	60	3	47	88	22	47	120	23	47	155	10	47	190	3
47	213	7	47	241	3	47	277	0	47	326	25	47	470	0	47	478	0
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48	82	20	48	112	10	48	141	28	48	177	22	48	204	11	48	236	1
48	272	22	48	312	4	48	359	18	48	366	0	48	374	0	49	1	21
49	13	11	49	18	23	49	39	0	49	50	1	49	72	17	49	106	21
49	141	22	49	172	5	49	196	12	49	228	15	49	261	22	49	299	28
49	353	8	49	381	0	49	389	0	50	14	13	50	21	15	50	25	20
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50	199	26	50	227	28	50	256	3	50	300	11	50	340	6	50	396	0
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51	73	1	51	99	10	51	132	1	51	166	31	51	199	0	51	222	9
51	259	21	51	292	20	51	334	24	51	411	0	51	419	0	52	15	21
52	16	27	52	28	7	52	37	11	52	67	22	52	97	13	52	149	14
52	175	30	52	187	6	52	218	18	52	271	10	52	282	26	52	347	15
52	426	0	52	434	0	53	4	20	53	20	19	53	31	15	53	38	9
53	70	0	53	103	28	53	122	2	53	162	7	53	180	2	53	213	19
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54	8	0	54	24	15	54	34	5	54	60	2	54	94	0	54	113	9
54	156	20	54	182	0	54	216	11	54	284	28	54	288	31	54	348	18
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55	61	3	55	89	22	55	121	23	55	156	10	55	191	3	55	214	7
55	242	3	55	278	0	55	327	25	55	471	0	55	479	0	56	2	9
56	11	24	56	23	6	56	26	6	56	35	20	56	55	3	56	83	20
56	113	10	56	142	28	56	178	22	56	205	11	56	237	1	56	273	22
56	313	4	56	352	19	56	367	0	56	375	0	57	2	21	57	14	11
57	19	23	57	32	1	57	51	1	57	73	17	57	107	21	57	142	22
57	173	5	57	197	12	57	229	15	57	262	22	57	300	28	57	354	8
57	382	0	57	390	0	58	15	13	58	22	15	58	26	20	58	33	8
58	53	2	58	76	12	58	117	2	58	130	12	58	166	17	58	192	27
58	228	28	58	257	3	58	301	11	58	341	6	58	397	0	58	405	0
59	3	14	59	12	9	59	19	4	59	28	0	59	40	27	59	74	1
59	100	10	59	133	1	59	167	31	59	192	1	59	223	9	59	260	21

59	293	20	59	335	24	59	412	0	59	420	0	60	8	22	60	17	27
60	29	7	60	38	11	60	68	22	60	98	13	60	150	14	60	168	31
60	188	6	60	219	18	60	264	11	60	283	26	60	348	15	60	427	0
60	435	0	61	5	20	61	21	19	61	24	16	61	39	9	61	71	0
61	96	29	61	123	2	61	163	7	61	181	2	61	214	19	61	253	5
61	321	19	61	355	9	61	442	0	61	450	0	62	4	7	62	9	0
62	25	15	62	35	5	62	61	2	62	95	0	62	114	9	62	157	20
62	183	0	62	217	11	62	285	28	62	289	31	62	349	18	62	457	0
62	465	0	63	1	18	63	16	6	63	30	27	63	34	23	63	63	0
63	94	6	63	126	11	63	155	23	63	177	29	63	212	23	63	251	16
63	315	30	63	320	2	63	362	0	63	472	0	64	2	13	64	13	11
64	16	26	64	38	5	64	71	13	64	85	5	64	106	22	64	136	25
64	175	31	64	205	21	64	234	1	64	269	1	64	308	3	64	346	14
64	368	0	64	376	0	65	3	21	65	15	11	65	20	23	65	33	1
65	52	1	65	74	17	65	108	21	65	143	22	65	174	5	65	198	12
65	230	15	65	263	22	65	301	28	65	355	8	65	383	0	65	391	0
66	8	14	66	23	15	66	27	20	66	34	8	66	54	2	66	77	12
66	118	2	66	131	12	66	167	17	66	193	27	66	229	28	66	258	3
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67	20	4	67	29	0	67	41	27	67	75	1	67	101	10	67	134	1
67	160	0	67	193	1	67	216	10	67	261	21	67	294	20	67	328	25
67	413	0	67	421	0	68	9	22	68	18	27	68	30	7	68	39	11
68	69	22	68	99	13	68	151	14	68	169	31	68	189	6	68	220	18
68	265	11	68	284	26	68	349	15	68	428	0	68	436	0	69	6	20
69	22	19	69	25	16	69	32	10	69	64	1	69	97	29	69	124	2
69	164	7	69	182	2	69	215	19	69	254	5	69	322	19	69	356	9
69	443	0	69	451	0	70	5	7	70	10	0	70	26	15	70	36	5
70	62	2	70	88	1	70	115	9	70	158	20	70	176	1	70	218	11
70	286	28	70	290	31	70	350	18	70	458	0	70	466	0	71	2	18
71	17	6	71	31	27	71	35	23	71	56	1	71	95	6	71	127	11
71	156	23	71	178	29	71	213	23	71	252	16	71	316	30	71	321	2
71	363	0	71	473	0	72	3	13	72	14	11	72	17	26	72	39	5
72	64	14	72	86	5	72	107	22	72	137	25	72	168	0	72	206	21
72	235	1	72	270	1	72	309	3	72	347	14	72	369	0	72	377	0
73	4	3	73	14	9	73	16	21	73	37	18	73	50	14	73	86	6
73	112	4	73	128	28	73	172	12	73	191	12	73	225	4	73	274	1
73	310	3	73	339	1	73	384	0	73	392	0	74	9	14	74	16	16
74	28	20	74	35	8	74	55	2	74	78	12	74	119	2	74	132	12
74	160	18	74	194	27	74	230	28	74	259	3	74	303	11	74	343	6
74	399	0	74	407	0	75	5	14	75	14	9	75	21	4	75	30	0
75	42	27	75	76	1	75	102	10	75	135	1	75	161	0	75	194	1
75	217	10	75	262	21	75	295	20	75	329	25	75	414	0	75	422	0
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76	144	15	76	170	31	76	190	6	76	221	18	76	266	11	76	285	26
76	350	15	76	429	0	76	437	0	77	7	20	77	23	19	77	26	16
77	33	10	77	65	1	77	98	29	77	125	2	77	165	7	77	183	2
77	208	20	77	255	5	77	323	19	77	357	9	77	444	0	77	452	0
78	6	7	78	11	0	78	27	15	78	37	5	78	63	2	78	89	1
78	116	9	78	159	20	78	177	1	78	219	11	78	287	28	78	291	31
78	351	18	78	459	0	78	467	0	79	3	18	79	18	6	79	24	28
79	36	23	79	57	1	79	88	7	79	120	12	79	157	23	79	179	29
79	214	23	79	253	16	79	317	30	79	322	2	79	364	0	79	474	0
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80	108	22	80	138	25	80	169	0	80	207	21	80	236	1	80	271	1
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81	17	21	81	38	18	81	51	14	81	87	6	81	113	4	81	129	28
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82	81	10	82	110	6	82	142	3	82	162	31	82	200	2	82	237	25
82	301	4	82	306	12	82	340	0	82	400	0	82	408	0	83	6	14
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83	128	2	83	162	0	83	195	1	83	218	10	83	263	21	83	288	21
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84	222	18	84	267	11	84	286	26	84	351	15	84	430	0	84	438	0
85	0	21	85	16	20	85	27	16	85	34	10	85	66	1	85	99	29
85	126	2	85	166	7	85	176	3	85	209	20	85	248	6	85	324	19
85	358	9	85	445	0	85	453	0	86	7	7	86	12	0	86	28	15
86	38	5	86	56	3	86	90	1	86	117	9	86	152	21	86	178	1
86	220	11	86	280	29	86	292	31	86	344	19	86	460	0	86	468	0
87	4	18	87	19	6	87	25	28	87	37	23	87	58	1	87	89	7
87	121	12	87	158	23	87	180	29	87	215	23	87	254	16	87	318	30
87	323	2	87	365	0	87	475	0	88	5	13	88	8	12	88	19	26
88	33	6	88	66	14	88	80	6	88	109	22	88	139	25	88	170	0
88	200	22	88	237	1	88	264	2	88	311	3	88	349	14	88	371	0
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89	80	7	89	114	4	89	130	28	89	174	12	89	185	13	89	227	4
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90	16	22	90	30	4	90	46	31	90	82	10	90	111	6	90	143	3
90	163	31	90	201	2	90	238	25	90	302	4	90	307	12	90	341	0
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91	45	1	91	74	11	91	103	2	91	151	0	91	152	28	91	205	26
91	247	13	91	253	10	91	319	14	91	361	0	91	416	0	91	424	0
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92	146	15	92	172	31	92	184	7	92	223	18	92	268	11	92	287	26
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93	210	20	93	249	6	93	325	19	93	359	9	93	446	0	93	454	0
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94	118	9	94	153	21	94	179	1	94	221	11	94	281	29	94	293	31
94	345	19	94	461	0	94	469	0	95	5	18	95	20	6	95	26	28
95	38	23	95	59	1	95	90	7	95	122	12	95	159	23	95	181	29
95	208	24	95	255	16	95	319	30	95	324	2	95	366	0	95	476	0
96	6	13	96	9	12	96	20	26	96	34	6	96	67	14	96	81	6
96	110	22	96	140	25	96	171	0	96	201	22	96	238	1	96	265	2
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97	175	12	97	186	13	97	228	4	97	277	1	97	305	4	97	342	1
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106	14	2	106	18	22	106	24	5	106	40	0	106	84	10	106	105	7
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107	207	26	107	241	14	107	255	10	107	313	15	107	363	0	107	418	0
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108	64	3	108	105	10	108	125	8	108	148	26	108	191	18	108	219	4
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112	69	14	112	83	6	112	104	23	112	142	25	112	173	0	112	203	22
112	232	2	112	267	2	112	306	4	112	344	15	112	374	0	112	382	0
113	1	4	113	11	10	113	21	21	113	34	19	113	55	14	113	83	7
113	117	4	113	133	28	113	169	13	113	188	13	113	230	4	113	279	1
113	307	4	113	336	2	113	389	0	113	397	0	114	15	2	114	19	22
114	25	5	114	41	0	114	85	10	114	106	7	114	138	4	114	166	31
114	204	2	114	233	26	114	297	5	114	310	12	114	336	1	114	404	0
114	412	0	115	6	25	115	12	1	115	21	8	115	24	10	115	40	2
115	77	11	115	98	3	115	146	1	115	155	28	115	200	27	115	242	14
115	248	11	115	314	15	115	364	0	115	419	0	115	427	0	116	3	27
116	11	27	116	20	30	116	29	28	116	35	11	116	65	3	116	106	10
116	126	8	116	149	26	116	184	19	116	220	4	116	267	1	116	284	7
116	335	3	116	434	0	116	442	0	117	0	24	117	8	22	117	28	20
117	32	3	117	59	29	117	88	29	117	131	10	117	147	13	117	199	20
117	208	31	117	247	27	117	295	24	117	333	2	117	449	0	117	457	0
118	1	10	118	25	27	118	38	7	118	40	26	118	62	2	118	90	21
118	122	22	118	157	9	118	184	3	118	215	6	118	243	2	118	279	31
118	320	25	118	464	0	118	472	0	119	0	19	119	23	6	119	29	28
119	33	24	119	62	1	119	93	7	119	125	12	119	154	24	119	176	30
119	211	24	119	250	17	119	314	31	119	327	2	119	361	1	119	479	0

Appendix Table G: Specification of the base matrix $\mathbf{B}_{\frac{4}{5}}$ for the rate-4/5 LDPC code

0	6	27	0	9	9	0	20	10	0	29	13	0	33	11	0	53	26
0	58	28	0	76	2	0	102	0	0	121	0	0	145	0	0	171	0
0	189	30	0	226	16	0	254	20	0	282	25	0	325	1	0	351	20
0	380	10	0	384	0	0	392	0	1	3	23	1	14	5	1	20	20
1	25	8	1	33	24	1	44	5	1	77	5	1	102	3	1	123	1
1	148	1	1	188	15	1	196	7	1	219	7	1	252	1	1	281	5
1	312	24	1	345	23	1	374	21	1	396	0	1	404	0	2	2	19
2	11	8	2	21	13	2	30	6	2	34	9	2	72	31	2	88	0
2	112	0	2	136	0	2	167	10	2	188	19	2	223	15	2	247	19
2	280	17	2	319	0	2	339	9	2	371	11	2	408	0	2	416	0
3	7	19	3	13	5	3	16	23	3	31	7	3	34	24	3	41	3
3	69	3	3	88	1	3	124	17	3	142	0	3	164	13	3	180	13
3	214	9	3	256	9	3	279	28	3	307	1	3	334	9	3	361	29
3	420	0	3	428	0	4	3	0	4	9	0	4	21	0	4	29	1
4	33	9	4	58	3	4	86	2	4	107	10	4	131	5	4	161	8
4	177	7	4	206	17	4	233	13	4	267	13	4	300	8	4	355	5
4	385	0	4	432	0	4	440	0	5	0	1	5	10	1	5	16	20
5	25	20	5	34	13	5	69	27	5	97	19	5	114	10	5	141	5
5	155	10	5	179	28	5	205	0	5	233	11	5	270	30	5	300	5
5	323	13	5	354	23	5	444	0	5	452	0	6	0	0	6	15	1
6	23	29	6	29	17	6	37	9	6	53	31	6	83	13	6	104	22
6	130	4	6	154	1	6	193	8	6	213	25	6	224	18	6	279	3
6	290	29	6	334	4	6	362	4	6	456	0	6	464	0	7	1	8
7	13	6	7	19	18	7	26	26	7	33	4	7	49	3	7	76	25
7	103	0	7	128	8	7	148	8	7	168	6	7	192	22	7	245	2
7	257	7	7	293	1	7	337	28	7	363	2	7	468	0	7	476	0
8	7	27	8	10	9	8	21	10	8	30	13	8	34	11	8	54	26
8	59	28	8	77	2	8	103	0	8	122	0	8	146	0	8	172	0
8	190	30	8	227	16	8	255	20	8	283	25	8	326	1	8	344	21
8	381	10	8	385	0	8	393	0	9	4	23	9	15	5	9	21	20
9	26	8	9	34	24	9	45	5	9	78	5	9	103	3	9	124	1
9	149	1	9	189	15	9	197	7	9	220	7	9	253	1	9	282	5
9	313	24	9	346	23	9	375	21	9	397	0	9	405	0	10	3	19
10	12	8	10	22	13	10	31	6	10	35	9	10	73	31	10	89	0
10	113	0	10	137	0	10	160	11	10	189	19	10	216	16	10	240	20
10	281	17	10	312	1	10	340	9	10	372	11	10	409	0	10	417	0
11	0	20	11	14	5	11	17	23	11	24	8	11	35	24	11	42	3
11	70	3	11	89	1	11	125	17	11	143	0	11	165	13	11	181	13
11	215	9	11	257	9	11	272	29	11	308	1	11	335	9	11	362	29
11	421	0	11	429	0	12	4	0	12	10	0	12	22	0	12	30	1
12	34	9	12	59	3	12	87	2	12	108	10	12	132	5	12	162	8
12	178	7	12	207	17	12	234	13	12	268	13	12	301	8	12	356	5
12	386	0	12	433	0	12	441	0	13	1	1	13	11	1	13	17	20
13	26	20	13	35	13	13	70	27	13	98	19	13	115	10	13	142	5
13	156	10	13	180	28	13	206	0	13	234	11	13	271	30	13	301	5
13	324	13	13	355	23	13	445	0	13	453	0	14	1	0	14	8	2
14	16	30	14	30	17	14	38	9	14	54	31	14	84	13	14	105	22
14	131	4	14	155	1	14	194	8	14	214	25	14	225	18	14	272	4
14	291	29	14	335	4	14	363	4	14	457	0	14	465	0	15	2	8
15	14	6	15	20	18	15	27	26	15	34	4	15	50	3	15	77	25
15	96	1	15	129	8	15	149	8	15	169	6	15	193	22	15	246	2

15	258	7	15	294	1	15	338	28	15	364	2	15	469	0	15	477	0
16	0	28	16	11	9	16	22	10	16	31	13	16	35	11	16	55	26
16	60	28	16	78	2	16	96	1	16	123	0	16	147	0	16	173	0
16	191	30	16	228	16	16	248	21	16	284	25	16	327	1	16	345	21
16	382	10	16	386	0	16	394	0	17	5	23	17	8	6	17	22	20
17	27	8	17	35	24	17	46	5	17	79	5	17	96	4	17	125	1
17	150	1	17	190	15	17	198	7	17	221	7	17	254	1	17	283	5
17	314	24	17	347	23	17	368	22	17	398	0	17	406	0	18	4	19
18	13	8	18	23	13	18	24	7	18	36	9	18	74	31	18	90	0
18	114	0	18	138	0	18	161	11	18	190	19	18	217	16	18	241	20
18	282	17	18	313	1	18	341	9	18	373	11	18	410	0	18	418	0
19	1	20	19	15	5	19	18	23	19	25	8	19	36	24	19	43	3
19	71	3	19	90	1	19	126	17	19	136	1	19	166	13	19	182	13
19	208	10	19	258	9	19	273	29	19	309	1	19	328	10	19	363	29
19	422	0	19	430	0	20	5	0	20	11	0	20	23	0	20	31	1
20	35	9	20	60	3	20	80	3	20	109	10	20	133	5	20	163	8
20	179	7	20	200	18	20	235	13	20	269	13	20	302	8	20	357	5
20	387	0	20	434	0	20	442	0	21	2	1	21	12	1	21	18	20
21	27	20	21	36	13	21	71	27	21	99	19	21	116	10	21	143	5
21	157	10	21	181	28	21	207	0	21	235	11	21	264	31	21	302	5
21	325	13	21	356	23	21	446	0	21	454	0	22	2	0	22	9	2
22	17	30	22	31	17	22	39	9	22	55	31	22	85	13	22	106	22
22	132	4	22	156	1	22	195	8	22	215	25	22	226	18	22	273	4
22	292	29	22	328	5	22	364	4	22	458	0	22	466	0	23	3	8
23	15	6	23	21	18	23	28	26	23	35	4	23	51	3	23	78	25
23	97	1	23	130	8	23	150	8	23	170	6	23	194	22	23	247	2
23	259	7	23	295	1	23	339	28	23	365	2	23	470	0	23	478	0
24	1	28	24	12	9	24	23	10	24	24	14	24	36	11	24	48	27
24	61	28	24	79	2	24	97	1	24	124	0	24	148	0	24	174	0
24	184	31	24	229	16	24	249	21	24	285	25	24	320	2	24	346	21
24	383	10	24	387	0	24	395	0	25	6	23	25	9	6	25	23	20
25	28	8	25	36	24	25	47	5	25	72	6	25	97	4	25	126	1
25	151	1	25	191	15	25	199	7	25	222	7	25	255	1	25	284	5
25	315	24	25	348	23	25	369	22	25	399	0	25	407	0	26	5	19
26	14	8	26	16	14	26	25	7	26	37	9	26	75	31	26	91	0
26	115	0	26	139	0	26	162	11	26	191	19	26	218	16	26	242	20
26	283	17	26	314	1	26	342	9	26	374	11	26	411	0	26	419	0
27	2	20	27	8	6	27	19	23	27	26	8	27	37	24	27	44	3
27	64	4	27	91	1	27	127	17	27	137	1	27	167	13	27	183	13
27	209	10	27	259	9	27	274	29	27	310	1	27	329	10	27	364	29
27	423	0	27	431	0	28	6	0	28	12	0	28	16	1	28	24	2
28	36	9	28	61	3	28	81	3	28	110	10	28	134	5	28	164	8
28	180	7	28	201	18	28	236	13	28	270	13	28	303	8	28	358	5
28	388	0	28	435	0	28	443	0	29	3	1	29	13	1	29	19	20
29	28	20	29	37	13	29	64	28	29	100	19	29	117	10	29	136	6
29	158	10	29	182	28	29	200	1	29	236	11	29	265	31	29	303	5
29	326	13	29	357	23	29	447	0	29	455	0	30	3	0	30	10	2
30	18	30	30	24	18	30	32	10	30	48	0	30	86	13	30	107	22
30	133	4	30	157	1	30	196	8	30	208	26	30	227	18	30	274	4
30	293	29	30	329	5	30	365	4	30	459	0	30	467	0	31	4	8
31	8	7	31	22	18	31	29	26	31	36	4	31	52	3	31	79	25
31	98	1	31	131	8	31	151	8	31	171	6	31	195	22	31	240	3
31	260	7	31	288	2	31	340	28	31	366	2	31	471	0	31	479	0

32	2	28	32	13	9	32	16	11	32	25	14	32	37	11	32	49	27
32	62	28	32	72	3	32	98	1	32	125	0	32	149	0	32	175	0
32	185	31	32	230	16	32	250	21	32	286	25	32	321	2	32	347	21
32	376	11	32	388	0	32	396	0	33	2	28	33	14	12	33	22	0
33	31	18	33	35	6	33	40	1	33	70	28	33	94	17	33	118	26
33	140	29	33	171	5	33	188	29	33	217	0	33	251	9	33	273	21
33	319	11	33	341	14	33	383	31	33	400	0	33	408	0	34	6	19
34	15	8	34	17	14	34	26	7	34	38	9	34	76	31	34	92	0
34	116	0	34	140	0	34	163	11	34	184	20	34	219	16	34	243	20
34	284	17	34	315	1	34	343	9	34	375	11	34	412	0	34	420	0
35	2	7	35	13	29	35	16	30	35	30	21	35	35	2	35	50	10
35	57	26	35	92	6	35	116	4	35	152	6	35	162	0	35	178	6
35	209	1	35	244	1	35	265	28	35	304	13	35	347	29	35	373	2
35	424	0	35	432	0	36	7	0	36	13	0	36	17	1	36	25	2
36	37	9	36	62	3	36	82	3	36	111	10	36	135	5	36	165	8
36	181	7	36	202	18	36	237	13	36	271	13	36	296	9	36	359	5
36	389	0	36	436	0	36	444	0	37	4	9	37	11	1	37	19	0
37	30	7	37	38	5	37	65	15	37	81	1	37	106	0	37	128	0
37	152	2	37	194	7	37	200	9	37	236	21	37	258	9	37	306	24
37	333	8	37	380	1	37	448	0	37	456	0	38	4	0	38	11	2
38	19	30	38	25	18	38	33	10	38	49	0	38	87	13	38	108	22
38	134	4	38	158	1	38	197	8	38	209	26	38	228	18	38	275	4
38	294	29	38	330	5	38	366	4	38	460	0	38	468	0	39	5	8
39	13	28	39	18	21	39	25	24	39	34	16	39	47	19	39	57	14
39	81	20	39	110	13	39	127	24	39	144	0	39	169	20	39	200	22
39	225	1	39	294	30	39	297	4	39	320	2	39	354	1	39	386	0
39	472	0	40	3	28	40	14	9	40	17	11	40	26	14	40	38	11
40	50	27	40	63	28	40	73	3	40	99	1	40	126	0	40	150	0
40	168	1	40	186	31	40	231	16	40	251	21	40	287	25	40	322	2
40	348	21	40	377	11	40	389	0	40	397	0	41	3	28	41	15	12
41	23	0	41	24	19	41	36	6	41	41	1	41	71	28	41	95	17
41	119	26	41	141	29	41	172	5	41	189	29	41	218	0	41	252	9
41	274	21	41	312	12	41	342	14	41	376	0	41	401	0	41	409	0
42	7	19	42	8	9	42	18	14	42	27	7	42	39	9	42	77	31
42	93	0	42	117	0	42	141	0	42	164	11	42	185	20	42	220	16
42	244	20	42	285	17	42	316	1	42	336	10	42	368	12	42	413	0
42	421	0	43	3	7	43	14	29	43	17	30	43	31	21	43	36	2
43	51	10	43	58	26	43	93	6	43	117	4	43	153	6	43	163	0
43	179	6	43	210	1	43	245	1	43	266	28	43	305	13	43	348	29
43	374	2	43	425	0	43	433	0	44	0	1	44	14	0	44	18	1
44	26	2	44	38	9	44	63	3	44	83	3	44	104	11	44	128	6
44	166	8	44	182	7	44	203	18	44	238	13	44	264	14	44	297	9
44	352	6	44	390	0	44	437	0	44	445	0	45	5	9	45	12	1
45	20	0	45	31	7	45	39	5	45	66	15	45	82	1	45	107	0
45	129	0	45	153	2	45	195	7	45	201	9	45	237	21	45	259	9
45	307	24	45	334	8	45	381	1	45	449	0	45	457	0	46	5	0
46	12	2	46	20	30	46	26	18	46	34	10	46	50	0	46	80	14
46	109	22	46	135	4	46	159	1	46	198	8	46	210	26	46	229	18
46	276	4	46	295	29	46	331	5	46	367	4	46	461	0	46	469	0
47	6	8	47	14	28	47	19	21	47	26	24	47	35	16	47	40	20
47	58	14	47	82	20	47	111	13	47	120	25	47	145	0	47	170	20
47	201	22	47	226	1	47	295	30	47	298	4	47	321	2	47	355	1
47	387	0	47	473	0	48	4	28	48	15	9	48	18	11	48	27	14

48	39	11	48	51	27	48	56	29	48	74	3	48	100	1	48	127	0
48	151	0	48	169	1	48	187	31	48	224	17	48	252	21	48	280	26
48	323	2	48	349	21	48	378	11	48	390	0	48	398	0	49	4	28
49	8	13	49	16	1	49	25	19	49	37	6	49	42	1	49	64	29
49	88	18	49	112	27	49	142	29	49	173	5	49	190	29	49	219	0
49	253	9	49	275	21	49	313	12	49	343	14	49	377	0	49	402	0
49	410	0	50	0	20	50	9	9	50	19	14	50	28	7	50	32	10
50	78	31	50	94	0	50	118	0	50	142	0	50	165	11	50	186	20
50	221	16	50	245	20	50	286	17	50	317	1	50	337	10	50	369	12
50	414	0	50	422	0	51	4	7	51	15	29	51	18	30	51	24	22
51	37	2	51	52	10	51	59	26	51	94	6	51	118	4	51	154	6
51	164	0	51	180	6	51	211	1	51	246	1	51	267	28	51	306	13
51	349	29	51	375	2	51	426	0	51	434	0	52	1	1	52	15	0
52	19	1	52	27	2	52	39	9	52	56	4	52	84	3	52	105	11
52	129	6	52	167	8	52	183	7	52	204	18	52	239	13	52	265	14
52	298	9	52	353	6	52	391	0	52	438	0	52	446	0	53	6	9
53	13	1	53	21	0	53	24	8	53	32	6	53	67	15	53	83	1
53	108	0	53	130	0	53	154	2	53	196	7	53	202	9	53	238	21
53	260	9	53	308	24	53	335	8	53	382	1	53	450	0	53	458	0
54	6	0	54	13	2	54	21	30	54	27	18	54	35	10	54	51	0
54	81	14	54	110	22	54	128	5	54	152	2	54	199	8	54	211	26
54	230	18	54	277	4	54	288	30	54	332	5	54	360	5	54	462	0
54	470	0	55	7	8	55	15	28	55	20	21	55	27	24	55	36	16
55	41	20	55	59	14	55	83	20	55	104	14	55	121	25	55	146	0
55	171	20	55	202	22	55	227	1	55	288	31	55	299	4	55	322	2
55	356	1	55	388	0	55	474	0	56	5	28	56	8	10	56	19	11
56	28	14	56	32	12	56	52	27	56	57	29	56	75	3	56	101	1
56	120	1	56	144	1	56	170	1	56	188	31	56	225	17	56	253	21
56	281	26	56	324	2	56	350	21	56	379	11	56	391	0	56	399	0
57	5	28	57	9	13	57	17	1	57	26	19	57	38	6	57	43	1
57	65	29	57	89	18	57	113	27	57	143	29	57	174	5	57	191	29
57	220	0	57	254	9	57	276	21	57	314	12	57	336	15	57	378	0
57	403	0	57	411	0	58	1	20	58	10	9	58	20	14	58	29	7
58	33	10	58	79	31	58	95	0	58	119	0	58	143	0	58	166	11
58	187	20	58	222	16	58	246	20	58	287	17	58	318	1	58	338	10
58	370	12	58	415	0	58	423	0	59	5	7	59	8	30	59	19	30
59	25	22	59	38	2	59	53	10	59	60	26	59	95	6	59	119	4
59	155	6	59	165	0	59	181	6	59	212	1	59	247	1	59	268	28
59	307	13	59	350	29	59	368	3	59	427	0	59	435	0	60	2	1
60	8	1	60	20	1	60	28	2	60	32	10	60	57	4	60	85	3
60	106	11	60	130	6	60	160	9	60	176	8	60	205	18	60	232	14
60	266	14	60	299	9	60	354	6	60	384	1	60	439	0	60	447	0
61	7	9	61	14	1	61	22	0	61	25	8	61	33	6	61	68	15
61	84	1	61	109	0	61	131	0	61	155	2	61	197	7	61	203	9
61	239	21	61	261	9	61	309	24	61	328	9	61	383	1	61	451	0
61	459	0	62	7	0	62	14	2	62	22	30	62	28	18	62	36	10
62	52	0	62	82	14	62	111	22	62	129	5	62	153	2	62	192	9
62	212	26	62	231	18	62	278	4	62	289	30	62	333	5	62	361	5
62	463	0	62	471	0	63	0	9	63	8	29	63	21	21	63	28	24
63	37	16	63	42	20	63	60	14	63	84	20	63	105	14	63	122	25
63	147	0	63	172	20	63	203	22	63	228	1	63	289	31	63	300	4
63	323	2	63	357	1	63	389	0	63	475	0	64	7	22	64	10	5
64	16	20	64	29	7	64	37	23	64	40	5	64	73	5	64	98	3

64	127	0	64	144	1	64	184	15	64	192	7	64	223	6	64	248	1
64	285	4	64	316	23	64	349	22	64	370	21	64	392	0	64	400	0
65	6	28	65	10	13	65	18	1	65	27	19	65	39	6	65	44	1
65	66	29	65	90	18	65	114	27	65	136	30	65	175	5	65	184	30
65	221	0	65	255	9	65	277	21	65	315	12	65	337	15	65	379	0
65	404	0	65	412	0	66	3	19	66	9	5	66	20	22	66	27	7
66	38	23	66	45	2	66	65	3	66	92	0	66	120	17	66	138	0
66	160	13	66	176	13	66	210	9	66	260	8	66	275	28	66	311	0
66	330	9	66	365	28	66	416	0	66	424	0	67	6	7	67	9	30
67	20	30	67	26	22	67	39	2	67	54	10	67	61	26	67	88	7
67	112	5	67	156	6	67	166	0	67	182	6	67	213	1	67	240	2
67	269	28	67	308	13	67	351	29	67	369	3	67	428	0	67	436	0
68	4	0	68	14	0	68	20	19	68	29	19	68	38	12	68	65	27
68	101	18	68	118	9	68	137	5	68	159	9	68	183	27	68	201	0
68	237	10	68	266	30	68	296	5	68	327	12	68	358	22	68	440	0
68	448	0	69	0	10	69	15	1	69	23	0	69	26	8	69	34	6
69	69	15	69	85	1	69	110	0	69	132	0	69	156	2	69	198	7
69	204	9	69	232	22	69	262	9	69	310	24	69	329	9	69	376	2
69	452	0	69	460	0	70	5	7	70	9	6	70	23	17	70	30	25
70	37	3	70	53	2	70	72	25	70	99	0	70	132	7	70	144	8
70	172	5	70	196	21	70	241	2	70	261	6	70	289	1	70	341	27
70	367	1	70	464	0	70	472	0	71	1	9	71	9	29	71	22	21
71	29	24	71	38	16	71	43	20	71	61	14	71	85	20	71	106	14
71	123	25	71	148	0	71	173	20	71	204	22	71	229	1	71	290	31
71	301	4	71	324	2	71	358	1	71	390	0	71	476	0	72	0	23
72	11	5	72	17	20	72	30	7	72	38	23	72	41	5	72	74	5
72	99	3	72	120	1	72	145	1	72	185	15	72	193	7	72	216	7
72	249	1	72	286	4	72	317	23	72	350	22	72	371	21	72	393	0
72	401	0	73	7	28	73	11	13	73	19	1	73	28	19	73	32	7
73	45	1	73	67	29	73	91	18	73	115	27	73	137	30	73	168	6
73	185	30	73	222	0	73	248	10	73	278	21	73	316	12	73	338	15
73	380	0	73	405	0	73	413	0	74	4	19	74	10	5	74	21	22
74	28	7	74	39	23	74	46	2	74	66	3	74	93	0	74	121	17
74	139	0	74	161	13	74	177	13	74	211	9	74	261	8	74	276	28
74	304	1	74	331	9	74	366	28	74	417	0	74	425	0	75	7	7
75	10	30	75	21	30	75	27	22	75	32	3	75	55	10	75	62	26
75	89	7	75	113	5	75	157	6	75	167	0	75	183	6	75	214	1
75	241	2	75	270	28	75	309	13	75	344	30	75	370	3	75	429	0
75	437	0	76	5	0	76	15	0	76	21	19	76	30	19	76	39	12
76	66	27	76	102	18	76	119	9	76	138	5	76	152	10	76	176	28
76	202	0	76	238	10	76	267	30	76	297	5	76	320	13	76	359	22
76	441	0	76	449	0	77	1	10	77	8	2	77	16	1	77	27	8
77	35	6	77	70	15	77	86	1	77	111	0	77	133	0	77	157	2
77	199	7	77	205	9	77	233	22	77	263	9	77	311	24	77	330	9
77	377	2	77	453	0	77	461	0	78	6	7	78	10	6	78	16	18
78	31	25	78	38	3	78	54	2	78	73	25	78	100	0	78	133	7
78	145	8	78	173	5	78	197	21	78	242	2	78	262	6	78	290	1
78	342	27	78	360	2	78	465	0	78	473	0	79	2	9	79	10	29
79	23	21	79	30	24	79	39	16	79	44	20	79	62	14	79	86	20
79	107	14	79	124	25	79	149	0	79	174	20	79	205	22	79	230	1
79	291	31	79	302	4	79	325	2	79	359	1	79	391	0	79	477	0
80	1	23	80	12	5	80	18	20	80	31	7	80	39	23	80	42	5
80	75	5	80	100	3	80	121	1	80	146	1	80	186	15	80	194	7

80	217	7	80	250	1	80	287	4	80	318	23	80	351	22	80	372	21
80	394	0	80	402	0	81	0	29	81	12	13	81	20	1	81	29	19
81	33	7	81	46	1	81	68	29	81	92	18	81	116	27	81	138	30
81	169	6	81	186	30	81	223	0	81	249	10	81	279	21	81	317	12
81	339	15	81	381	0	81	406	0	81	414	0	82	5	19	82	11	5
82	22	22	82	29	7	82	32	24	82	47	2	82	67	3	82	94	0
82	122	17	82	140	0	82	162	13	82	178	13	82	212	9	82	262	8
82	277	28	82	305	1	82	332	9	82	367	28	82	418	0	82	426	0
83	0	8	83	11	30	83	22	30	83	28	22	83	33	3	83	48	11
83	63	26	83	90	7	83	114	5	83	158	6	83	160	1	83	176	7
83	215	1	83	242	2	83	271	28	83	310	13	83	345	30	83	371	3
83	430	0	83	438	0	84	6	0	84	8	1	84	22	19	84	31	19
84	32	13	84	67	27	84	103	18	84	112	10	84	139	5	84	153	10
84	177	28	84	203	0	84	239	10	84	268	30	84	298	5	84	321	13
84	352	23	84	442	0	84	450	0	85	2	10	85	9	2	85	17	1
85	28	8	85	36	6	85	71	15	85	87	1	85	104	1	85	134	0
85	158	2	85	192	8	85	206	9	85	234	22	85	256	10	85	304	25
85	331	9	85	378	2	85	454	0	85	462	0	86	7	7	86	11	6
86	17	18	86	24	26	86	39	3	86	55	2	86	74	25	86	101	0
86	134	7	86	146	8	86	174	5	86	198	21	86	243	2	86	263	6
86	291	1	86	343	27	86	361	2	86	466	0	86	474	0	87	3	9
87	11	29	87	16	22	87	31	24	87	32	17	87	45	20	87	63	14
87	87	20	87	108	14	87	125	25	87	150	0	87	175	20	87	206	22
87	231	1	87	292	31	87	303	4	87	326	2	87	352	2	87	384	1
87	478	0	88	2	23	88	13	5	88	19	20	88	24	8	88	32	24
88	43	5	88	76	5	88	101	3	88	122	1	88	147	1	88	187	15
88	195	7	88	218	7	88	251	1	88	280	5	88	319	23	88	344	23
88	373	21	88	395	0	88	403	0	89	1	29	89	13	13	89	21	1
89	30	19	89	34	7	89	47	1	89	69	29	89	93	18	89	117	27
89	139	30	89	170	6	89	187	30	89	216	1	89	250	10	89	272	22
89	318	12	89	340	15	89	382	0	89	407	0	89	415	0	90	6	19
90	12	5	90	23	22	90	30	7	90	33	24	90	40	3	90	68	3
90	95	0	90	123	17	90	141	0	90	163	13	90	179	13	90	213	9
90	263	8	90	278	28	90	306	1	90	333	9	90	360	29	90	419	0
90	427	0	91	1	8	91	12	30	91	23	30	91	29	22	91	34	3
91	49	11	91	56	27	91	91	7	91	115	5	91	159	6	91	161	1
91	177	7	91	208	2	91	243	2	91	264	29	91	311	13	91	346	30
91	372	3	91	431	0	91	439	0	92	7	0	92	9	1	92	23	19
92	24	20	92	33	13	92	68	27	92	96	19	92	113	10	92	140	5
92	154	10	92	178	28	92	204	0	92	232	11	92	269	30	92	299	5
92	322	13	92	353	23	92	443	0	92	451	0	93	3	10	93	10	2
93	18	1	93	29	8	93	37	6	93	64	16	93	80	2	93	105	1
93	135	0	93	159	2	93	193	8	93	207	9	93	235	22	93	257	10
93	305	25	93	332	9	93	379	2	93	455	0	93	463	0	94	0	8
94	12	6	94	18	18	94	25	26	94	32	4	94	48	3	94	75	25
94	102	0	94	135	7	94	147	8	94	175	5	94	199	21	94	244	2
94	256	7	94	292	1	94	336	28	94	362	2	94	467	0	94	475	0
95	4	9	95	12	29	95	17	22	95	24	25	95	33	17	95	46	20
95	56	15	95	80	21	95	109	14	95	126	25	95	151	0	95	168	21
95	207	22	95	224	2	95	293	31	95	296	5	95	327	2	95	353	2
95	385	1	95	479	0												

Appendix Table H: Specification of the base matrix $B_{\frac{5}{6}}$ for the rate-5/6 LDPC code

0	7	16	0	15	20	0	19	28	0	26	11	0	35	1	0	40	16
0	56	31	0	74	18	0	88	12	0	105	5	0	126	18	0	144	27
0	163	1	0	187	6	0	202	0	0	230	0	0	241	13	0	266	10
0	293	31	0	326	6	0	349	1	0	368	7	0	399	18	0	400	0
0	408	0	1	4	1	1	11	0	1	17	1	1	25	1	1	36	16
1	40	24	1	58	17	1	76	14	1	107	28	1	126	1	1	139	1
1	162	3	1	177	28	1	202	2	1	229	3	1	240	22	1	259	6
1	295	7	1	316	10	1	339	30	1	373	22	1	396	8	1	410	0
1	418	0	2	0	15	2	15	30	2	23	11	2	26	0	2	32	8
2	46	15	2	49	4	2	75	18	2	86	22	2	100	22	2	117	13
2	141	9	2	153	27	2	182	1	2	194	17	2	216	16	2	245	15
2	262	3	2	282	1	2	315	1	2	348	12	2	360	15	2	389	20
2	420	0	2	428	0	3	2	10	3	13	3	3	20	4	3	30	24
3	38	0	3	44	6	3	52	31	3	79	23	3	100	10	3	119	18
3	157	2	3	164	1	3	183	1	3	204	7	3	218	2	3	242	28
3	256	15	3	282	22	3	306	11	3	343	4	3	363	20	3	387	0
3	430	0	3	438	0	4	4	21	4	10	1	4	23	22	4	30	24
4	34	27	4	41	15	4	55	31	4	65	0	4	91	15	4	114	31
4	149	17	4	155	2	4	187	6	4	197	1	4	210	16	4	233	14
4	251	10	4	274	7	4	300	30	4	332	29	4	355	27	4	401	0
4	440	0	4	448	0	5	0	1	5	8	27	5	16	5	5	29	30
5	36	30	5	45	11	5	65	1	5	90	0	5	118	25	5	134	23
5	151	10	5	172	0	5	187	4	5	211	9	5	238	10	5	251	1
5	265	25	5	301	4	5	330	11	5	357	16	5	380	11	5	450	0
5	458	0	6	5	20	6	13	25	6	20	11	6	31	8	6	35	17
6	44	5	6	71	15	6	80	26	6	90	11	6	106	13	6	124	0
6	146	1	6	163	12	6	199	3	6	202	23	6	233	3	6	249	18
6	308	29	6	314	11	6	322	1	6	373	15	6	395	10	6	460	0
6	468	0	7	3	1	7	8	1	7	18	1	7	30	0	7	37	8
7	44	3	7	63	4	7	80	10	7	110	4	7	134	20	7	140	10
7	175	23	7	186	1	7	213	31	7	225	13	7	248	0	7	278	21
7	299	2	7	328	1	7	352	15	7	377	5	7	470	0	7	478	0
8	0	17	8	8	21	8	20	28	8	27	11	8	36	1	8	41	16
8	57	31	8	75	18	8	89	12	8	106	5	8	127	18	8	145	27
8	164	1	8	188	6	8	203	0	8	231	0	8	242	13	8	267	10
8	294	31	8	327	6	8	350	1	8	369	7	8	392	19	8	401	0
8	409	0	9	5	1	9	12	0	9	18	1	9	26	1	9	37	16
9	41	24	9	59	17	9	77	14	9	108	28	9	127	1	9	140	1
9	163	3	9	178	28	9	203	2	9	230	3	9	241	22	9	260	6
9	288	8	9	317	10	9	340	30	9	374	22	9	397	8	9	411	0
9	419	0	10	1	15	10	8	31	10	16	12	10	27	0	10	33	8
10	47	15	10	50	4	10	76	18	10	87	22	10	101	22	10	118	13
10	142	9	10	154	27	10	183	1	10	195	17	10	217	16	10	246	15
10	263	3	10	283	1	10	316	1	10	349	12	10	361	15	10	390	20
10	421	0	10	429	0	11	3	10	11	14	3	11	21	4	11	31	24
11	39	0	11	45	6	11	53	31	11	72	24	11	101	10	11	112	19
11	158	2	11	165	1	11	176	2	11	205	7	11	219	2	11	243	28
11	257	15	11	283	22	11	307	11	11	336	5	11	364	20	11	388	0
11	431	0	11	439	0	12	5	21	12	11	1	12	16	23	12	31	24
12	35	27	12	42	15	12	48	0	12	66	0	12	92	15	12	115	31

12	150	17	12	156	2	12	188	6	12	198	1	12	211	16	12	234	14
12	252	10	12	275	7	12	301	30	12	333	29	12	356	27	12	402	0
12	441	0	12	449	0	13	1	1	13	9	27	13	17	5	13	30	30
13	37	30	13	46	11	13	66	1	13	91	0	13	119	25	13	135	23
13	144	11	13	173	0	13	188	4	13	212	9	13	239	10	13	252	1
13	266	25	13	302	4	13	331	11	13	358	16	13	381	11	13	451	0
13	459	0	14	6	20	14	14	25	14	21	11	14	24	9	14	36	17
14	45	5	14	64	16	14	81	26	14	91	11	14	107	13	14	125	0
14	147	1	14	164	12	14	192	4	14	203	23	14	234	3	14	250	18
14	309	29	14	315	11	14	323	1	14	374	15	14	396	10	14	461	0
14	469	0	15	4	1	15	9	1	15	19	1	15	31	0	15	38	8
15	45	3	15	56	5	15	81	10	15	111	4	15	135	20	15	141	10
15	168	24	15	187	1	15	214	31	15	226	13	15	249	0	15	279	21
15	300	2	15	329	1	15	353	15	15	378	5	15	471	0	15	479	0
16	1	17	16	9	21	16	21	28	16	28	11	16	37	1	16	42	16
16	58	31	16	76	18	16	90	12	16	107	5	16	120	19	16	146	27
16	165	1	16	189	6	16	204	0	16	224	1	16	243	13	16	268	10
16	295	31	16	320	7	16	351	1	16	370	7	16	393	19	16	402	0
16	410	0	17	6	1	17	13	0	17	19	1	17	27	1	17	38	16
17	42	24	17	60	17	17	78	14	17	109	28	17	120	2	17	141	1
17	164	3	17	179	28	17	204	2	17	231	3	17	242	22	17	261	6
17	289	8	17	318	10	17	341	30	17	375	22	17	398	8	17	412	0
17	420	0	18	2	15	18	9	31	18	17	12	18	28	0	18	34	8
18	40	16	18	51	4	18	77	18	18	80	23	18	102	22	18	119	13
18	143	9	18	155	27	18	176	2	18	196	17	18	218	16	18	247	15
18	256	4	18	284	1	18	317	1	18	350	12	18	362	15	18	391	20
18	422	0	18	430	0	19	5	11	19	10	22	19	21	2	19	31	20
19	32	20	19	40	12	19	51	2	19	66	10	19	97	2	19	122	1
19	130	15	19	156	0	19	175	26	19	193	1	19	218	8	19	239	24
19	258	12	19	280	20	19	307	0	19	338	14	19	361	11	19	384	25
19	432	0	19	440	0	20	6	21	20	12	1	20	17	23	20	24	25
20	36	27	20	43	15	20	49	0	20	67	0	20	93	15	20	116	31
20	151	17	20	157	2	20	189	6	20	199	1	20	212	16	20	235	14
20	253	10	20	276	7	20	302	30	20	334	29	20	357	27	20	403	0
20	442	0	20	450	0	21	2	1	21	10	27	21	18	5	21	31	30
21	38	30	21	47	11	21	67	1	21	92	0	21	112	26	21	128	24
21	145	11	21	174	0	21	189	4	21	213	9	21	232	11	21	253	1
21	267	25	21	303	4	21	332	11	21	359	16	21	382	11	21	452	0
21	460	0	22	7	20	22	15	25	22	22	11	22	25	9	22	37	17
22	46	5	22	65	16	22	82	26	22	92	11	22	108	13	22	126	0
22	148	1	22	165	12	22	193	4	22	204	23	22	235	3	22	251	18
22	310	29	22	316	11	22	324	1	22	375	15	22	397	10	22	462	0
22	470	0	23	7	20	23	15	27	23	22	4	23	27	16	23	34	22
23	40	17	23	59	1	23	83	26	23	99	17	23	133	10	23	137	5
23	169	13	23	183	16	23	214	17	23	216	25	23	225	15	23	268	5
23	276	24	23	294	24	23	322	0	23	345	9	23	383	1	23	402	0
23	472	0	24	2	17	24	10	21	24	22	28	24	29	11	24	38	1
24	43	16	24	59	31	24	77	18	24	91	12	24	108	5	24	121	19
24	147	27	24	166	1	24	190	6	24	205	0	24	225	1	24	244	13
24	269	10	24	288	0	24	321	7	24	344	2	24	371	7	24	394	19
24	403	0	24	411	0	25	7	1	25	14	0	25	20	1	25	28	1
25	39	16	25	43	24	25	61	17	25	79	14	25	110	28	25	121	2
25	142	1	25	165	3	25	180	28	25	205	2	25	224	4	25	243	22

25	262	6	25	290	8	25	319	10	25	342	30	25	368	23	25	399	8
25	413	0	25	421	0	26	3	15	26	10	31	26	18	12	26	29	0
26	35	8	26	41	16	26	52	4	26	78	18	26	81	23	26	103	22
26	112	14	26	136	10	26	156	27	26	177	2	26	197	17	26	219	16
26	240	16	26	257	4	26	285	1	26	318	1	26	351	12	26	363	15
26	384	21	26	423	0	26	431	0	27	6	11	27	11	22	27	22	2
27	24	21	27	33	20	27	41	12	27	52	2	27	67	10	27	98	2
27	123	1	27	131	15	27	157	0	27	168	27	27	194	1	27	219	8
27	232	25	27	259	12	27	281	20	27	308	0	27	339	14	27	362	11
27	385	25	27	433	0	27	441	0	28	7	21	28	13	1	28	18	23
28	25	25	28	37	27	28	44	15	28	50	0	28	68	0	28	94	15
28	117	31	28	144	18	28	158	2	28	190	6	28	192	2	28	213	16
28	236	14	28	254	10	28	277	7	28	303	30	28	335	29	28	358	27
28	404	0	28	443	0	28	451	0	29	3	1	29	11	27	29	19	5
29	24	31	29	39	30	29	40	12	29	68	1	29	93	0	29	113	26
29	129	24	29	146	11	29	175	0	29	190	4	29	214	9	29	233	11
29	254	1	29	268	25	29	296	5	29	333	11	29	352	17	29	383	11
29	453	0	29	461	0	30	0	21	30	8	26	30	23	11	30	26	9
30	38	17	30	47	5	30	66	16	30	83	26	30	93	11	30	109	13
30	127	0	30	149	1	30	166	12	30	194	4	30	205	23	30	236	3
30	252	18	30	311	29	30	317	11	30	325	1	30	368	16	30	398	10
30	463	0	30	471	0	31	0	21	31	8	28	31	23	4	31	28	16
31	35	22	31	41	17	31	60	1	31	84	26	31	100	17	31	134	10
31	138	5	31	170	13	31	176	17	31	215	17	31	217	25	31	226	15
31	269	5	31	277	24	31	295	24	31	323	0	31	346	9	31	376	2
31	403	0	31	473	0	32	3	17	32	11	21	32	23	28	32	30	11
32	39	1	32	44	16	32	60	31	32	78	18	32	92	12	32	109	5
32	122	19	32	148	27	32	167	1	32	191	6	32	206	0	32	226	1
32	245	13	32	270	10	32	289	0	32	322	7	32	345	2	32	372	7
32	395	19	32	404	0	32	412	0	33	0	2	33	15	0	33	21	1
33	29	1	33	32	17	33	44	24	33	62	17	33	72	15	33	111	28
33	122	2	33	143	1	33	166	3	33	181	28	33	206	2	33	225	4
33	244	22	33	263	6	33	291	8	33	312	11	33	343	30	33	369	23
33	392	9	33	414	0	33	422	0	34	4	9	34	15	2	34	22	3
34	24	24	34	32	0	34	46	5	34	54	30	34	73	23	34	102	9
34	113	18	34	159	1	34	166	0	34	177	1	34	206	6	34	220	1
34	244	27	34	258	14	34	284	21	34	308	10	34	337	4	34	365	19
34	389	31	34	424	0	34	432	0	35	7	11	35	12	22	35	23	2
35	25	21	35	34	20	35	42	12	35	53	2	35	68	10	35	99	2
35	124	1	35	132	15	35	158	0	35	169	27	35	195	1	35	220	8
35	233	25	35	260	12	35	282	20	35	309	0	35	340	14	35	363	11
35	386	25	35	434	0	35	442	0	36	0	22	36	14	1	36	19	23
36	26	25	36	38	27	36	45	15	36	51	0	36	69	0	36	95	15
36	118	31	36	145	18	36	159	2	36	191	6	36	193	2	36	214	16
36	237	14	36	255	10	36	278	7	36	296	31	36	328	30	36	359	27
36	405	0	36	444	0	36	452	0	37	4	1	37	12	27	37	20	5
37	25	31	37	32	31	37	41	12	37	69	1	37	94	0	37	114	26
37	130	24	37	147	11	37	168	1	37	191	4	37	215	9	37	234	11
37	255	1	37	269	25	37	297	5	37	334	11	37	353	17	37	376	12
37	454	0	37	462	0	38	5	0	38	10	0	38	20	0	38	24	0
38	39	7	38	46	2	38	57	4	38	82	9	38	104	4	38	128	20
38	142	9	38	169	23	38	188	0	38	215	30	38	227	12	38	250	31
38	272	21	38	301	1	38	330	0	38	354	14	38	379	4	38	464	0

38	472	0	39	1	21	39	9	28	39	16	5	39	29	16	39	36	22
39	42	17	39	61	1	39	85	26	39	101	17	39	135	10	39	139	5
39	171	13	39	177	17	39	208	18	39	218	25	39	227	15	39	270	5
39	278	24	39	288	25	39	324	0	39	347	9	39	377	2	39	404	0
39	474	0	40	4	17	40	12	21	40	16	29	40	31	11	40	32	2
40	45	16	40	61	31	40	79	18	40	93	12	40	110	5	40	123	19
40	149	27	40	160	2	40	184	7	40	207	0	40	227	1	40	246	13
40	271	10	40	290	0	40	323	7	40	346	2	40	373	7	40	396	19
40	405	0	40	413	0	41	1	2	41	8	1	41	22	1	41	30	1
41	33	17	41	45	24	41	63	17	41	73	15	41	104	29	41	123	2
41	136	2	41	167	3	41	182	28	41	207	2	41	226	4	41	245	22
41	256	7	41	292	8	41	313	11	41	336	31	41	370	23	41	393	9
41	415	0	41	423	0	42	5	9	42	8	3	42	23	3	42	25	24
42	33	0	42	47	5	42	55	30	42	74	23	42	103	9	42	114	18
42	152	2	42	167	0	42	178	1	42	207	6	42	221	1	42	245	27
42	259	14	42	285	21	42	309	10	42	338	4	42	366	19	42	390	31
42	425	0	42	433	0	43	0	12	43	13	22	43	16	3	43	26	21
43	35	20	43	43	12	43	54	2	43	69	10	43	100	2	43	125	1
43	133	15	43	159	0	43	170	27	43	196	1	43	221	8	43	234	25
43	261	12	43	283	20	43	310	0	43	341	14	43	364	11	43	387	25
43	435	0	43	443	0	44	1	22	44	15	1	44	20	23	44	27	25
44	39	27	44	46	15	44	52	0	44	70	0	44	88	16	44	119	31
44	146	18	44	152	3	44	184	7	44	194	2	44	215	16	44	238	14
44	248	11	44	279	7	44	297	31	44	329	30	44	352	28	44	406	0
44	445	0	44	453	0	45	5	1	45	13	27	45	21	5	45	26	31
45	33	31	45	42	12	45	70	1	45	95	0	45	115	26	45	131	24
45	148	11	45	169	1	45	184	5	45	208	10	45	235	11	45	248	2
45	270	25	45	298	5	45	335	11	45	354	17	45	377	12	45	455	0
45	463	0	46	6	0	46	11	0	46	21	0	46	25	0	46	32	8
46	47	2	46	58	4	46	83	9	46	105	4	46	129	20	46	143	9
46	170	23	46	189	0	46	208	31	46	228	12	46	251	31	46	273	21
46	302	1	46	331	0	46	355	14	46	380	4	46	465	0	46	473	0
47	2	21	47	10	28	47	17	5	47	30	16	47	37	22	47	43	17
47	62	1	47	86	26	47	102	17	47	128	11	47	140	5	47	172	13
47	178	17	47	209	18	47	219	25	47	228	15	47	271	5	47	279	24
47	289	25	47	325	0	47	348	9	47	378	2	47	405	0	47	475	0
48	5	17	48	13	21	48	17	29	48	24	12	48	33	2	48	46	16
48	62	31	48	72	19	48	94	12	48	111	5	48	124	19	48	150	27
48	161	2	48	185	7	48	200	1	48	228	1	48	247	13	48	264	11
48	291	0	48	324	7	48	347	2	48	374	7	48	397	19	48	406	0
48	414	0	49	4	14	49	11	30	49	19	11	49	30	31	49	36	7
49	42	15	49	53	3	49	79	17	49	82	22	49	96	22	49	113	13
49	137	9	49	157	26	49	178	1	49	198	16	49	220	15	49	241	15
49	258	3	49	286	0	49	319	0	49	344	12	49	364	14	49	385	20
49	416	0	49	424	0	50	6	9	50	9	3	50	16	4	50	26	24
50	34	0	50	40	6	50	48	31	50	75	23	50	96	10	50	115	18
50	153	2	50	160	1	50	179	1	50	200	7	50	222	1	50	246	27
50	260	14	50	286	21	50	310	10	50	339	4	50	367	19	50	391	31
50	426	0	50	434	0	51	1	12	51	14	22	51	17	3	51	27	21
51	36	20	51	44	12	51	55	2	51	70	10	51	101	2	51	126	1
51	134	15	51	152	1	51	171	27	51	197	1	51	222	8	51	235	25
51	262	12	51	284	20	51	311	0	51	342	14	51	365	11	51	388	25
51	436	0	51	444	0	52	2	22	52	8	2	52	21	23	52	28	25

52	32	28	52	47	15	52	53	0	52	71	0	52	89	16	52	112	0
52	147	18	52	153	3	52	185	7	52	195	2	52	208	17	52	239	14
52	249	11	52	272	8	52	298	31	52	330	30	52	353	28	52	407	0
52	446	0	52	454	0	53	1	20	53	9	25	53	16	11	53	27	8
53	39	16	53	40	5	53	67	15	53	84	25	53	94	10	53	110	12
53	120	0	53	150	0	53	167	11	53	195	3	53	206	22	53	237	2
53	253	17	53	304	29	53	318	10	53	326	0	53	369	15	53	399	9
53	456	0	53	464	0	54	7	0	54	12	0	54	22	0	54	26	0
54	33	8	54	40	3	54	59	4	54	84	9	54	106	4	54	130	20
54	136	10	54	171	23	54	190	0	54	209	31	54	229	12	54	252	31
54	274	21	54	303	1	54	332	0	54	356	14	54	381	4	54	466	0
54	474	0	55	3	21	55	11	28	55	18	5	55	31	16	55	38	22
55	44	17	55	63	1	55	87	26	55	103	17	55	129	11	55	141	5
55	173	13	55	179	17	55	210	18	55	220	25	55	229	15	55	264	6
55	272	25	55	290	25	55	326	0	55	349	9	55	379	2	55	406	0
55	476	0	56	6	17	56	14	21	56	18	29	56	25	12	56	34	2
56	47	16	56	63	31	56	73	19	56	95	12	56	104	6	56	125	19
56	151	27	56	162	2	56	186	7	56	201	1	56	229	1	56	240	14
56	265	11	56	292	0	56	325	7	56	348	2	56	375	7	56	398	19
56	407	0	56	415	0	57	5	14	57	12	30	57	20	11	57	31	31
57	37	7	57	43	15	57	54	3	57	72	18	57	83	22	57	97	22
57	114	13	57	138	9	57	158	26	57	179	1	57	199	16	57	221	15
57	242	15	57	259	3	57	287	0	57	312	1	57	345	12	57	365	14
57	386	20	57	417	0	57	425	0	58	7	9	58	10	3	58	17	4
58	27	24	58	35	0	58	41	6	58	49	31	58	76	23	58	97	10
58	116	18	58	154	2	58	161	1	58	180	1	58	201	7	58	223	1
58	247	27	58	261	14	58	287	21	58	311	10	58	340	4	58	360	20
58	384	0	58	427	0	58	435	0	59	2	12	59	15	22	59	18	3
59	28	21	59	37	20	59	45	12	59	48	3	59	71	10	59	102	2
59	127	1	59	135	15	59	153	1	59	172	27	59	198	1	59	223	8
59	236	25	59	263	12	59	285	20	59	304	1	59	343	14	59	366	11
59	389	25	59	437	0	59	445	0	60	3	22	60	9	2	60	22	23
60	29	25	60	33	28	60	40	16	60	54	0	60	64	1	60	90	16
60	113	0	60	148	18	60	154	3	60	186	7	60	196	2	60	209	17
60	232	15	60	250	11	60	273	8	60	299	31	60	331	30	60	354	28
60	400	1	60	447	0	60	455	0	61	2	20	61	10	25	61	17	11
61	28	8	61	32	17	61	41	5	61	68	15	61	85	25	61	95	10
61	111	12	61	121	0	61	151	0	61	160	12	61	196	3	61	207	22
61	238	2	61	254	17	61	305	29	61	319	10	61	327	0	61	370	15
61	392	10	61	457	0	61	465	0	62	0	1	62	13	0	62	23	0
62	27	0	62	34	8	62	41	3	62	60	4	62	85	9	62	107	4
62	131	20	62	137	10	62	172	23	62	191	0	62	210	31	62	230	12
62	253	31	62	275	21	62	296	2	62	333	0	62	357	14	62	382	4
62	467	0	62	475	0	63	4	21	63	12	28	63	19	5	63	24	17
63	39	22	63	45	17	63	56	2	63	80	27	63	96	18	63	130	11
63	142	5	63	174	13	63	180	17	63	211	18	63	221	25	63	230	15
63	265	6	63	273	25	63	291	25	63	327	0	63	350	9	63	380	2
63	407	0	63	477	0	64	2	1	64	9	0	64	23	0	64	31	0
64	34	16	64	46	23	64	56	17	64	74	14	64	105	28	64	124	1
64	137	1	64	160	3	64	183	27	64	200	2	64	227	3	64	246	21
64	257	6	64	293	7	64	314	10	64	337	30	64	371	22	64	394	8
64	408	0	64	416	0	65	6	14	65	13	30	65	21	11	65	24	0
65	38	7	65	44	15	65	55	3	65	73	18	65	84	22	65	98	22

65	115	13	65	139	9	65	159	26	65	180	1	65	192	17	65	222	15
65	243	15	65	260	3	65	280	1	65	313	1	65	346	12	65	366	14
65	387	20	65	418	0	65	426	0	66	0	10	66	11	3	66	18	4
66	28	24	66	36	0	66	42	6	66	50	31	66	77	23	66	98	10
66	117	18	66	155	2	66	162	1	66	181	1	66	202	7	66	216	2
66	240	28	66	262	14	66	280	22	66	304	11	66	341	4	66	361	20
66	385	0	66	428	0	66	436	0	67	3	12	67	8	23	67	19	3
67	29	21	67	38	20	67	46	12	67	49	3	67	64	11	67	103	2
67	120	2	67	128	16	67	154	1	67	173	27	67	199	1	67	216	9
67	237	25	67	256	13	67	286	20	67	305	1	67	336	15	67	367	11
67	390	25	67	438	0	67	446	0	68	6	0	68	14	26	68	22	4
68	27	30	68	34	30	68	43	11	68	71	0	68	88	0	68	116	25
68	132	23	68	149	10	68	170	0	68	185	4	68	209	9	68	236	10
68	249	1	68	271	24	68	299	4	68	328	11	68	355	16	68	378	11
68	448	0	68	456	0	69	3	20	69	11	25	69	18	11	69	29	8
69	33	17	69	42	5	69	69	15	69	86	25	69	88	11	69	104	13
69	122	0	69	144	1	69	161	12	69	197	3	69	200	23	69	239	2
69	255	17	69	306	29	69	312	11	69	320	1	69	371	15	69	393	10
69	458	0	69	466	0	70	1	1	70	14	0	70	16	1	70	28	0
70	35	8	70	42	3	70	61	4	70	86	9	70	108	4	70	132	20
70	138	10	70	173	23	70	184	1	70	211	31	70	231	12	70	254	31
70	276	21	70	297	2	70	334	0	70	358	14	70	383	4	70	468	0
70	476	0	71	5	21	71	13	28	71	20	5	71	25	17	71	32	23
71	46	17	71	57	2	71	81	27	71	97	18	71	131	11	71	143	5
71	175	13	71	181	17	71	212	18	71	222	25	71	231	15	71	266	6
71	274	25	71	292	25	71	320	1	71	351	9	71	381	2	71	400	1
71	478	0	72	3	1	72	10	0	72	16	1	72	24	1	72	35	16
72	47	23	72	57	17	72	75	14	72	106	28	72	125	1	72	138	1
72	161	3	72	176	28	72	201	2	72	228	3	72	247	21	72	258	6
72	294	7	72	315	10	72	338	30	72	372	22	72	395	8	72	409	0
72	417	0	73	7	14	73	14	30	73	22	11	73	25	0	73	39	7
73	45	15	73	48	4	73	74	18	73	85	22	73	99	22	73	116	13
73	140	9	73	152	27	73	181	1	73	193	17	73	223	15	73	244	15
73	261	3	73	281	1	73	314	1	73	347	12	73	367	14	73	388	20
73	419	0	73	427	0	74	1	10	74	12	3	74	19	4	74	29	24
74	37	0	74	43	6	74	51	31	74	78	23	74	99	10	74	118	18
74	156	2	74	163	1	74	182	1	74	203	7	74	217	2	74	241	28
74	263	14	74	281	22	74	305	11	74	342	4	74	362	20	74	386	0
74	429	0	74	437	0	75	4	12	75	9	23	75	20	3	75	30	21
75	39	20	75	47	12	75	50	3	75	65	11	75	96	3	75	121	2
75	129	16	75	155	1	75	174	27	75	192	2	75	217	9	75	238	25
75	257	13	75	287	20	75	306	1	75	337	15	75	360	12	75	391	25
75	439	0	75	447	0	76	7	0	76	15	26	76	23	4	76	28	30
76	35	30	76	44	11	76	64	1	76	89	0	76	117	25	76	133	23
76	150	10	76	171	0	76	186	4	76	210	9	76	237	10	76	250	1
76	264	25	76	300	4	76	329	11	76	356	16	76	379	11	76	449	0
76	457	0	77	4	20	77	12	25	77	19	11	77	30	8	77	34	17
77	43	5	77	70	15	77	87	25	77	89	11	77	105	13	77	123	0
77	145	1	77	162	12	77	198	3	77	201	23	77	232	3	77	248	18
77	307	29	77	313	11	77	321	1	77	372	15	77	394	10	77	459	0
77	467	0	78	2	1	78	15	0	78	17	1	78	29	0	78	36	8
78	43	3	78	62	4	78	87	9	78	109	4	78	133	20	78	139	10
78	174	23	78	185	1	78	212	31	78	224	13	78	255	31	78	277	21

78	298	2	78	335	0	78	359	14	78	376	5	78	469	0	78	477	0
79	6	21	79	14	28	79	21	5	79	26	17	79	33	23	79	47	17
79	58	2	79	82	27	79	98	18	79	132	11	79	136	6	79	168	14
79	182	17	79	213	18	79	223	25	79	224	16	79	267	6	79	275	25
79	293	25	79	321	1	79	344	10	79	382	2	79	401	1	79	479	0

Appendix Table I: Specification of the base matrix $B_{\frac{13}{15}}$ for the rate-13/15 LDPC code

0	2	15	0	9	6	0	21	0	0	25	1	0	48	11	0	81	29
0	90	5	0	108	11	0	119	19	0	121	12	0	145	30	0	166	9
0	181	18	0	189	11	0	196	5	0	214	8	0	225	11	0	261	19
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46	175	23	46	192	21	46	215	29	46	223	23	46	244	8	46	255	7
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47	343	5	47	355	2	47	376	22	47	393	2	47	423	0	47	477	0
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48	388	11	48	415	0	48	422	0	48	430	0	49	1	24	49	8	28
49	23	28	49	24	4	49	50	6	49	61	1	49	82	27	49	92	22
49	106	7	49	123	28	49	145	23	49	162	12	49	176	9	49	199	4
49	214	3	49	230	1	49	240	2	49	268	5	49	281	11	49	310	0
49	325	10	49	345	1	49	372	4	49	390	17	49	410	22	49	430	0
49	438	0	50	7	0	50	14	5	50	19	2	50	27	27	50	47	1
50	55	2	50	69	22	50	87	28	50	108	15	50	125	24	50	139	5
50	155	31	50	177	22	50	205	18	50	214	29	50	231	20	50	236	20
50	259	7	50	275	3	50	297	19	50	317	23	50	339	30	50	363	5
50	395	22	50	402	28	50	438	0	50	446	0	51	2	2	51	9	1
51	23	1	51	29	2	51	47	13	51	67	29	51	85	20	51	98	5
51	108	26	51	139	1	51	158	24	51	165	7	51	171	30	51	186	14
51	201	16	51	231	18	51	237	4	51	258	2	51	272	28	51	299	3
51	314	1	51	337	1	51	360	0	51	378	29	51	407	3	51	446	0
51	454	0	52	5	13	52	9	3	52	16	15	52	26	7	52	36	1
52	48	7	52	65	19	52	72	24	52	102	20	52	132	1	52	136	1
52	159	13	52	169	15	52	188	2	52	205	4	52	216	5	52	246	3
52	255	11	52	272	1	52	290	25	52	315	29	52	335	11	52	354	13
52	398	3	52	423	0	52	454	0	52	462	0	53	1	4	53	8	1
53	23	5	53	24	5	53	38	25	53	60	7	53	77	30	53	95	25
53	116	1	53	130	3	53	140	27	53	147	8	53	161	1	53	183	5
53	204	10	53	219	5	53	232	19	53	255	0	53	281	24	53	327	12
53	333	19	53	349	13	53	368	11	53	387	11	53	414	26	53	462	0
53	470	0	54	10	26	54	20	16	54	25	3	54	37	18	54	44	17
54	58	30	54	75	3	54	96	9	54	114	7	54	129	25	54	145	5
54	168	24	54	193	21	54	208	30	54	216	24	54	245	8	54	248	8
54	293	0	54	301	11	54	311	5	54	359	0	54	361	4	54	378	19
54	405	10	54	470	0	54	478	0	55	1	28	55	38	2	55	47	22
55	62	4	55	71	8	55	74	28	55	92	5	55	96	19	55	114	14
55	123	13	55	135	2	55	154	7	55	174	10	55	186	22	55	197	21
55	221	22	55	232	4	55	242	31	55	266	14	55	295	30	55	327	18
55	336	6	55	356	2	55	377	22	55	394	2	55	416	1	55	478	0
56	1	16	56	8	7	56	20	1	56	24	2	56	55	11	56	80	30
56	89	6	56	107	12	56	118	20	56	120	13	56	144	31	56	165	10
56	180	19	56	188	12	56	195	6	56	213	9	56	224	12	56	260	20
56	265	4	56	283	12	56	309	1	56	334	2	56	348	8	56	375	20
56	389	11	56	408	1	56	423	0	56	431	0	57	2	24	57	9	28
57	16	29	57	25	4	57	51	6	57	62	1	57	83	27	57	93	22
57	107	7	57	124	28	57	146	23	57	163	12	57	177	9	57	192	5
57	215	3	57	231	1	57	241	2	57	269	5	57	282	11	57	311	0
57	326	10	57	346	1	57	373	4	57	391	17	57	411	22	57	431	0
57	439	0	58	0	1	58	15	5	58	20	2	58	28	27	58	40	2

58	48	3	58	70	22	58	80	29	58	109	15	58	126	24	58	140	5
58	156	31	58	178	22	58	206	18	58	215	29	58	224	21	58	237	20
58	260	7	58	276	3	58	298	19	58	318	23	58	340	30	58	364	5
58	396	22	58	403	28	58	439	0	58	447	0	59	3	2	59	10	1
59	16	2	59	30	2	59	40	14	59	68	29	59	86	20	59	99	5
59	109	26	59	140	1	59	159	24	59	166	7	59	172	30	59	187	14
59	202	16	59	224	19	59	238	4	59	259	2	59	273	28	59	300	3
59	315	1	59	338	1	59	361	0	59	379	29	59	400	4	59	447	0
59	455	0	60	6	13	60	10	3	60	17	15	60	27	7	60	37	1
60	49	7	60	66	19	60	73	24	60	103	20	60	133	1	60	137	1
60	152	14	60	170	15	60	189	2	60	206	4	60	217	5	60	247	3
60	248	12	60	273	1	60	291	25	60	316	29	60	328	12	60	355	13
60	399	3	60	416	1	60	455	0	60	463	0	61	2	4	61	9	1
61	16	6	61	25	5	61	39	25	61	61	7	61	78	30	61	88	26
61	117	1	61	131	3	61	141	27	61	148	8	61	162	1	61	176	6
61	205	10	61	220	5	61	233	19	61	248	1	61	282	24	61	320	13
61	334	19	61	350	13	61	369	11	61	388	11	61	415	26	61	463	0
61	471	0	62	11	26	62	21	16	62	26	3	62	38	18	62	45	17
62	59	30	62	76	3	62	97	9	62	115	7	62	130	25	62	146	5
62	169	24	62	194	21	62	209	30	62	217	24	62	246	8	62	249	8
62	294	0	62	302	11	62	304	6	62	352	1	62	362	4	62	379	19
62	406	10	62	471	0	62	479	0	63	2	28	63	39	2	63	40	23
63	63	4	63	64	9	63	75	28	63	93	5	63	97	19	63	115	14
63	124	13	63	128	3	63	155	7	63	175	10	63	187	22	63	198	21
63	222	22	63	233	4	63	243	31	63	267	14	63	288	31	63	320	19
63	337	6	63	357	2	63	378	22	63	395	2	63	417	1	63	479	0

Appendix Table J: Specification of the base matrix $B_{\frac{9}{10}}$ for the rate-9/10 LDPC code

0	13	0	0	16	0	0	33	1	0	46	22	0	56	0	0	65	30
0	80	0	0	92	29	0	134	27	0	144	17	0	161	9	0	174	29
0	187	22	0	197	18	0	204	28	0	209	26	0	227	16	0	238	7
0	245	8	0	249	5	0	263	22	0	270	29	0	274	16	0	282	5
0	308	14	0	318	1	0	325	0	0	331	19	0	347	11	0	361	29
0	382	28	0	400	22	0	423	13	0	426	29	0	432	0	0	440	0
1	11	1	1	22	0	1	39	1	1	44	23	1	62	0	1	71	30
1	86	0	1	90	30	1	132	28	1	150	17	1	167	9	1	172	30
1	185	23	1	195	19	1	202	29	1	215	26	1	225	17	1	236	8
1	243	9	1	255	5	1	261	23	1	268	30	1	272	17	1	280	6
1	306	15	1	316	2	1	323	1	1	329	20	1	345	12	1	367	29
1	380	29	1	406	22	1	421	14	1	424	30	1	438	0	1	446	0
2	14	20	2	21	1	2	34	14	2	45	0	2	59	9	2	69	0
2	80	8	2	94	0	2	104	7	2	116	1	2	131	19	2	139	4
2	145	1	2	167	20	2	175	15	2	183	2	2	184	5	2	192	23
2	212	16	2	226	24	2	242	17	2	256	15	2	265	30	2	283	2
2	299	29	2	305	3	2	313	13	2	329	25	2	344	7	2	363	3
2	381	3	2	393	9	2	413	25	2	425	19	2	444	0	2	452	0
3	7	18	3	18	4	3	30	18	3	43	1	3	50	27	3	70	1
3	78	24	3	94	0	3	99	29	3	113	2	3	122	0	3	134	5
3	148	0	3	158	0	3	161	26	3	172	9	3	199	18	3	208	6
3	222	9	3	225	4	3	244	0	3	261	22	3	264	4	3	285	30
3	294	11	3	317	8	3	321	4	3	335	15	3	349	8	3	366	27
3	380	22	3	393	4	3	414	1	3	422	21	3	450	0	3	458	0
4	0	0	4	21	14	4	28	0	4	44	11	4	51	0	4	66	4
4	73	0	4	91	1	4	99	0	4	105	19	4	124	9	4	135	2
4	141	10	4	158	1	4	182	2	4	192	26	4	201	10	4	214	15
4	223	8	4	231	20	4	239	21	4	254	25	4	274	29	4	280	17
4	290	2	4	303	4	4	318	10	4	343	17	4	358	30	4	374	12
4	389	27	4	395	27	4	411	1	4	433	0	4	456	0	4	464	0
5	6	0	5	19	15	5	26	1	5	42	12	5	49	1	5	64	5
5	79	0	5	89	2	5	97	1	5	111	19	5	122	10	5	133	3
5	139	11	5	156	2	5	180	3	5	198	26	5	207	10	5	212	16
5	221	9	5	229	21	5	237	22	5	252	26	5	272	30	5	286	17
5	288	3	5	301	5	5	316	11	5	341	18	5	356	31	5	372	13
5	387	28	5	393	28	5	409	2	5	439	0	5	462	0	5	470	0
6	7	3	6	15	15	6	24	7	6	35	31	6	52	0	6	56	10
6	72	2	6	87	13	6	99	1	6	110	0	6	117	0	6	122	27
6	138	2	6	157	28	6	161	2	6	174	0	6	181	22	6	188	26
6	205	7	6	220	10	6	239	6	6	251	29	6	258	9	6	273	23
6	292	11	6	302	0	6	311	7	6	322	3	6	340	13	6	356	21
6	372	27	6	385	31	6	400	6	6	429	23	6	468	0	6	476	0
7	3	7	7	9	0	7	24	3	7	35	23	7	50	1	7	63	4
7	78	7	7	84	16	7	99	0	7	110	30	7	118	0	7	125	22
7	138	10	7	151	17	7	152	9	7	176	5	7	190	4	7	204	0
7	223	29	7	232	12	7	245	26	7	255	8	7	268	21	7	274	0
7	295	0	7	303	2	7	305	14	7	327	3	7	340	2	7	356	0
7	371	7	7	385	6	7	404	7	7	416	27	7	436	0	7	474	0
8	14	0	8	17	0	8	34	1	8	47	22	8	57	0	8	66	30
8	81	0	8	93	29	8	135	27	8	145	17	8	162	9	8	175	29

8	188	22	8	198	18	8	205	28	8	210	26	8	228	16	8	239	7
8	246	8	8	250	5	8	256	23	8	271	29	8	275	16	8	283	5
8	309	14	8	319	1	8	326	0	8	332	19	8	348	11	8	362	29
8	383	28	8	401	22	8	416	14	8	427	29	8	433	0	8	441	0
9	12	1	9	23	0	9	32	2	9	45	23	9	63	0	9	64	31
9	87	0	9	91	30	9	133	28	9	151	17	9	160	10	9	173	30
9	186	23	9	196	19	9	203	29	9	208	27	9	226	17	9	237	8
9	244	9	9	248	6	9	262	23	9	269	30	9	273	17	9	281	6
9	307	15	9	317	2	9	324	1	9	330	20	9	346	12	9	360	30
9	381	29	9	407	22	9	422	14	9	425	30	9	439	0	9	447	0
10	15	20	10	22	1	10	35	14	10	46	0	10	60	9	10	70	0
10	81	8	10	95	0	10	105	7	10	117	1	10	132	19	10	140	4
10	146	1	10	160	21	10	168	16	10	176	3	10	185	5	10	193	23
10	213	16	10	227	24	10	243	17	10	257	15	10	266	30	10	284	2
10	300	29	10	306	3	10	314	13	10	330	25	10	345	7	10	364	3
10	382	3	10	394	9	10	414	25	10	426	19	10	445	0	10	453	0
11	0	19	11	19	4	11	31	18	11	44	1	11	51	27	11	71	1
11	79	24	11	95	0	11	100	29	11	114	2	11	123	0	11	135	5
11	149	0	11	159	0	11	162	26	11	173	9	11	192	19	11	209	6
11	223	9	11	226	4	11	245	0	11	262	22	11	265	4	11	286	30
11	295	11	11	318	8	11	322	4	11	328	16	11	350	8	11	367	27
11	381	22	11	394	4	11	415	1	11	423	21	11	451	0	11	459	0
12	1	0	12	22	14	12	29	0	12	45	11	12	52	0	12	67	4
12	74	0	12	92	1	12	100	0	12	106	19	12	125	9	12	128	3
12	142	10	12	159	1	12	183	2	12	193	26	12	202	10	12	215	15
12	216	9	12	224	21	12	232	22	12	255	25	12	275	29	12	281	17
12	291	2	12	296	5	12	319	10	12	336	18	12	359	30	12	375	12
12	390	27	12	396	27	12	412	1	12	434	0	12	457	0	12	465	0
13	7	0	13	20	15	13	27	1	13	43	12	13	50	1	13	65	5
13	72	1	13	90	2	13	98	1	13	104	20	13	123	10	13	134	3
13	140	11	13	157	2	13	181	3	13	199	26	13	200	11	13	213	16
13	222	9	13	230	21	13	238	22	13	253	26	13	273	30	13	287	17
13	289	3	13	302	5	13	317	11	13	342	18	13	357	31	13	373	13
13	388	28	13	394	28	13	410	2	13	432	1	13	463	0	13	471	0
14	0	4	14	8	16	14	25	7	14	36	31	14	53	0	14	57	10
14	73	2	14	80	14	14	100	1	14	111	0	14	118	0	14	123	27
14	139	2	14	158	28	14	162	2	14	175	0	14	182	22	14	189	26
14	206	7	14	221	10	14	232	7	14	252	29	14	259	9	14	274	23
14	293	11	14	303	0	14	304	8	14	323	3	14	341	13	14	357	21
14	373	27	14	386	31	14	401	6	14	430	23	14	469	0	14	477	0
15	4	7	15	10	0	15	25	3	15	36	23	15	51	1	15	56	5
15	79	7	15	85	16	15	100	0	15	111	30	15	119	0	15	126	22
15	139	10	15	144	18	15	153	9	15	177	5	15	191	4	15	205	0
15	216	30	15	233	12	15	246	26	15	248	9	15	269	21	15	275	0
15	288	1	15	296	3	15	306	14	15	320	4	15	341	2	15	357	0
15	372	7	15	386	6	15	405	7	15	417	27	15	437	0	15	475	0
16	15	0	16	18	0	16	35	1	16	40	23	16	58	0	16	67	30
16	82	0	16	94	29	16	128	28	16	146	17	16	163	9	16	168	30
16	189	22	16	199	18	16	206	28	16	211	26	16	229	16	16	232	8
16	247	8	16	251	5	16	257	23	16	264	30	16	276	16	16	284	5
16	310	14	16	312	2	16	327	0	16	333	19	16	349	11	16	363	29
16	376	29	16	402	22	16	417	14	16	428	29	16	434	0	16	442	0
17	10	20	17	17	1	17	38	13	17	41	0	17	63	8	17	65	0

17	84	7	17	90	0	17	108	6	17	112	1	17	135	18	17	143	3
17	149	0	17	163	20	17	171	15	17	179	2	17	188	4	17	196	22
17	208	16	17	230	23	17	246	16	17	260	14	17	269	29	17	287	1
17	303	28	17	309	2	17	317	12	17	333	24	17	348	6	17	367	2
17	377	3	17	397	8	17	409	25	17	429	18	17	440	0	17	448	0
18	8	21	18	23	1	18	36	14	18	47	0	18	61	9	18	71	0
18	82	8	18	88	1	18	106	7	18	118	1	18	133	19	18	141	4
18	147	1	18	161	21	18	169	16	18	177	3	18	186	5	18	194	23
18	214	16	18	228	24	18	244	17	18	258	15	18	267	30	18	285	2
18	301	29	18	307	3	18	315	13	18	331	25	18	346	7	18	365	3
18	383	3	18	395	9	18	415	25	18	427	19	18	446	0	18	454	0
19	1	19	19	20	4	19	24	19	19	45	1	19	52	27	19	64	2
19	72	25	19	88	1	19	101	29	19	115	2	19	124	0	19	128	6
19	150	0	19	152	1	19	163	26	19	174	9	19	193	19	19	210	6
19	216	10	19	227	4	19	246	0	19	263	22	19	266	4	19	287	30
19	288	12	19	319	8	19	323	4	19	329	16	19	351	8	19	360	28
19	382	22	19	395	4	19	408	2	19	416	22	19	452	0	19	460	0
20	2	0	20	23	14	20	30	0	20	46	11	20	53	0	20	68	4
20	75	0	20	93	1	20	101	0	20	107	19	20	126	9	20	129	3
20	143	10	20	152	2	20	176	3	20	194	26	20	203	10	20	208	16
20	217	9	20	225	21	20	233	22	20	248	26	20	276	29	20	282	17
20	292	2	20	297	5	20	312	11	20	337	18	20	352	31	20	368	13
20	391	27	20	397	27	20	413	1	20	435	0	20	458	0	20	466	0
21	3	3	21	11	15	21	28	6	21	39	30	21	48	0	21	60	9
21	76	1	21	83	13	21	103	0	21	106	0	21	113	0	21	126	26
21	142	1	21	153	28	21	165	1	21	170	0	21	177	22	21	184	26
21	201	7	21	216	10	21	235	6	21	255	28	21	262	8	21	277	22
21	288	11	21	298	0	21	307	7	21	326	2	21	336	13	21	352	21
21	368	27	21	389	30	21	404	5	21	425	23	21	464	0	21	472	0
22	1	4	22	9	16	22	26	7	22	37	31	22	54	0	22	58	10
22	74	2	22	81	14	22	101	1	22	104	1	22	119	0	22	124	27
22	140	2	22	159	28	22	163	2	22	168	1	22	183	22	22	190	26
22	207	7	22	222	10	22	233	7	22	253	29	22	260	9	22	275	23
22	294	11	22	296	1	22	305	8	22	324	3	22	342	13	22	358	21
22	374	27	22	387	31	22	402	6	22	431	23	22	470	0	22	478	0
23	5	7	23	11	0	23	26	3	23	37	23	23	52	1	23	57	5
23	72	8	23	86	16	23	101	0	23	104	31	23	112	1	23	127	22
23	140	10	23	145	18	23	154	9	23	178	5	23	184	5	23	206	0
23	217	30	23	234	12	23	247	26	23	249	9	23	270	21	23	276	0
23	289	1	23	297	3	23	307	14	23	321	4	23	342	2	23	358	0
23	373	7	23	387	6	23	406	7	23	418	27	23	438	0	23	476	0
24	8	1	24	19	0	24	36	1	24	41	23	24	59	0	24	68	30
24	83	0	24	95	29	24	129	28	24	147	17	24	164	9	24	169	30
24	190	22	24	192	19	24	207	28	24	212	26	24	230	16	24	233	8
24	240	9	24	252	5	24	258	23	24	265	30	24	277	16	24	285	5
24	311	14	24	313	2	24	320	1	24	334	19	24	350	11	24	364	29
24	377	29	24	403	22	24	418	14	24	429	29	24	435	0	24	443	0
25	11	20	25	18	1	25	39	13	25	42	0	25	56	9	25	66	0
25	85	7	25	91	0	25	109	6	25	113	1	25	128	19	25	136	4
25	150	0	25	164	20	25	172	15	25	180	2	25	189	4	25	197	22
25	209	16	25	231	23	25	247	16	25	261	14	25	270	29	25	280	2
25	296	29	25	310	2	25	318	12	25	334	24	25	349	6	25	360	3
25	378	3	25	398	8	25	410	25	25	430	18	25	441	0	25	449	0

26	9	21	26	16	2	26	37	14	26	40	1	26	62	9	26	64	1
26	83	8	26	89	1	26	107	7	26	119	1	26	134	19	26	142	4
26	148	1	26	162	21	26	170	16	26	178	3	26	187	5	26	195	23
26	215	16	26	229	24	26	245	17	26	259	15	26	268	30	26	286	2
26	302	29	26	308	3	26	316	13	26	332	25	26	347	7	26	366	3
26	376	4	26	396	9	26	408	26	26	428	19	26	447	0	26	455	0
27	2	19	27	21	4	27	25	19	27	46	1	27	53	27	27	65	2
27	73	25	27	89	1	27	102	29	27	116	2	27	125	0	27	129	6
27	151	0	27	153	1	27	164	26	27	175	9	27	194	19	27	211	6
27	217	10	27	228	4	27	247	0	27	256	23	27	267	4	27	280	31
27	289	12	27	312	9	27	324	4	27	330	16	27	344	9	27	361	28
27	383	22	27	396	4	27	409	2	27	417	22	27	453	0	27	461	0
28	3	0	28	16	15	28	31	0	28	47	11	28	54	0	28	69	4
28	76	0	28	94	1	28	102	0	28	108	19	28	127	9	28	130	3
28	136	11	28	153	2	28	177	3	28	195	26	28	204	10	28	209	16
28	218	9	28	226	21	28	234	22	28	249	26	28	277	29	28	283	17
28	293	2	28	298	5	28	313	11	28	338	18	28	353	31	28	369	13
28	384	28	28	398	27	28	414	1	28	436	0	28	459	0	28	467	0
29	4	3	29	12	15	29	29	6	29	32	31	29	49	0	29	61	9
29	77	1	29	84	13	29	96	1	29	107	0	29	114	0	29	127	26
29	143	1	29	154	28	29	166	1	29	171	0	29	178	22	29	185	26
29	202	7	29	217	10	29	236	6	29	248	29	29	263	8	29	278	22
29	289	11	29	299	0	29	308	7	29	327	2	29	337	13	29	353	21
29	369	27	29	390	30	29	405	5	29	426	23	29	465	0	29	473	0
30	2	4	30	10	16	30	27	7	30	38	31	30	55	0	30	59	10
30	75	2	30	82	14	30	102	1	30	105	1	30	112	1	30	125	27
30	141	2	30	152	29	30	164	2	30	169	1	30	176	23	30	191	26
30	200	8	30	223	10	30	234	7	30	254	29	30	261	9	30	276	23
30	295	11	30	297	1	30	306	8	30	325	3	30	343	13	30	359	21
30	375	27	30	388	31	30	403	6	30	424	24	30	471	0	30	479	0
31	6	7	31	12	0	31	27	3	31	38	23	31	53	1	31	58	5
31	73	8	31	87	16	31	102	0	31	105	31	31	113	1	31	120	23
31	141	10	31	146	18	31	155	9	31	179	5	31	185	5	31	207	0
31	218	30	31	235	12	31	240	27	31	250	9	31	271	21	31	277	0
31	290	1	31	298	3	31	308	14	31	322	4	31	343	2	31	359	0
31	374	7	31	388	6	31	407	7	31	419	27	31	439	0	31	477	0
32	9	1	32	20	0	32	37	1	32	42	23	32	60	0	32	69	30
32	84	0	32	88	30	32	130	28	32	148	17	32	165	9	32	170	30
32	191	22	32	193	19	32	200	29	32	213	26	32	231	16	32	234	8
32	241	9	32	253	5	32	259	23	32	266	30	32	278	16	32	286	5
32	304	15	32	314	2	32	321	1	32	335	19	32	351	11	32	365	29
32	378	29	32	404	22	32	419	14	32	430	29	32	436	0	32	444	0
33	12	20	33	19	1	33	32	14	33	43	0	33	57	9	33	67	0
33	86	7	33	92	0	33	110	6	33	114	1	33	129	19	33	137	4
33	151	0	33	165	20	33	173	15	33	181	2	33	190	4	33	198	22
33	210	16	33	224	24	33	240	17	33	262	14	33	271	29	33	281	2
33	297	29	33	311	2	33	319	12	33	335	24	33	350	6	33	361	3
33	379	3	33	399	8	33	411	25	33	431	18	33	442	0	33	450	0
34	5	18	34	16	4	34	28	18	34	41	1	34	48	27	34	68	1
34	76	24	34	92	0	34	97	29	34	119	1	34	120	0	34	132	5
34	146	0	34	156	0	34	167	25	34	170	9	34	197	18	34	214	5
34	220	9	34	231	3	34	242	0	34	259	22	34	270	3	34	283	30
34	292	11	34	315	8	34	327	3	34	333	15	34	347	8	34	364	27

34	378	22	34	399	3	34	412	1	34	420	21	34	448	0	34	456	0
35	3	19	35	22	4	35	26	19	35	47	1	35	54	27	35	66	2
35	74	25	35	90	1	35	103	29	35	117	2	35	126	0	35	130	6
35	144	1	35	154	1	35	165	26	35	168	10	35	195	19	35	212	6
35	218	10	35	229	4	35	240	1	35	257	23	35	268	4	35	281	31
35	290	12	35	313	9	35	325	4	35	331	16	35	345	9	35	362	28
35	376	23	35	397	4	35	410	2	35	418	22	35	454	0	35	462	0
36	4	0	36	17	15	36	24	1	36	40	12	36	55	0	36	70	4
36	77	0	36	95	1	36	103	0	36	109	19	36	120	10	36	131	3
36	137	11	36	154	2	36	178	3	36	196	26	36	205	10	36	210	16
36	219	9	36	227	21	36	235	22	36	250	26	36	278	29	36	284	17
36	294	2	36	299	5	36	314	11	36	339	18	36	354	31	36	370	13
36	385	28	36	399	27	36	415	1	36	437	0	36	460	0	36	468	0
37	5	3	37	13	15	37	30	6	37	33	31	37	50	0	37	62	9
37	78	1	37	85	13	37	97	1	37	108	0	37	115	0	37	120	27
37	136	2	37	155	28	37	167	1	37	172	0	37	179	22	37	186	26
37	203	7	37	218	10	37	237	6	37	249	29	37	256	9	37	279	22
37	290	11	37	300	0	37	309	7	37	320	3	37	338	13	37	354	21
37	370	27	37	391	30	37	406	5	37	427	23	37	466	0	37	474	0
38	1	7	38	15	31	38	30	2	38	33	23	38	48	1	38	61	4
38	76	7	38	82	16	38	97	0	38	108	30	38	116	0	38	123	22
38	136	10	38	149	17	38	158	8	38	182	4	38	188	4	38	202	0
38	221	29	38	238	11	38	243	26	38	253	8	38	266	21	38	272	0
38	293	0	38	301	2	38	311	13	38	325	3	38	338	2	38	354	0
38	369	7	38	391	5	38	402	7	38	422	26	38	434	0	38	472	0
39	7	7	39	13	0	39	28	3	39	39	23	39	54	1	39	59	5
39	74	8	39	80	17	39	103	0	39	106	31	39	114	1	39	121	23
39	142	10	39	147	18	39	156	9	39	180	5	39	186	5	39	200	1
39	219	30	39	236	12	39	241	27	39	251	9	39	264	22	39	278	0
39	291	1	39	299	3	39	309	14	39	323	4	39	336	3	39	352	1
39	375	7	39	389	6	39	400	8	39	420	27	39	432	1	39	478	0
40	10	1	40	21	0	40	38	1	40	43	23	40	61	0	40	70	30
40	85	0	40	89	30	40	131	28	40	149	17	40	166	9	40	171	30
40	184	23	40	194	19	40	201	29	40	214	26	40	224	17	40	235	8
40	242	9	40	254	5	40	260	23	40	267	30	40	279	16	40	287	5
40	305	15	40	315	2	40	322	1	40	328	20	40	344	12	40	366	29
40	379	29	40	405	22	40	420	14	40	431	29	40	437	0	40	445	0
41	13	20	41	20	1	41	33	14	41	44	0	41	58	9	41	68	0
41	87	7	41	93	0	41	111	6	41	115	1	41	130	19	41	138	4
41	144	1	41	166	20	41	174	15	41	182	2	41	191	4	41	199	22
41	211	16	41	225	24	41	241	17	41	263	14	41	264	30	41	282	2
41	298	29	41	304	3	41	312	13	41	328	25	41	351	6	41	362	3
41	380	3	41	392	9	41	412	25	41	424	19	41	443	0	41	451	0
42	6	18	42	17	4	42	29	18	42	42	1	42	49	27	42	69	1
42	77	24	42	93	0	42	98	29	42	112	2	42	121	0	42	133	5
42	147	0	42	157	0	42	160	26	42	171	9	42	198	18	42	215	5
42	221	9	42	224	4	42	243	0	42	260	22	42	271	3	42	284	30
42	293	11	42	316	8	42	320	4	42	334	15	42	348	8	42	365	27
42	379	22	42	392	4	42	413	1	42	421	21	42	449	0	42	457	0
43	4	19	43	23	4	43	27	19	43	40	2	43	55	27	43	67	2
43	75	25	43	91	1	43	96	30	43	118	2	43	127	0	43	131	6
43	145	1	43	155	1	43	166	26	43	169	10	43	196	19	43	213	6
43	219	10	43	230	4	43	241	1	43	258	23	43	269	4	43	282	31

43	291	12	43	314	9	43	326	4	43	332	16	43	346	9	43	363	28
43	377	23	43	398	4	43	411	2	43	419	22	43	455	0	43	463	0
44	5	0	44	18	15	44	25	1	44	41	12	44	48	1	44	71	4
44	78	0	44	88	2	44	96	1	44	110	19	44	121	10	44	132	3
44	138	11	44	155	2	44	179	3	44	197	26	44	206	10	44	211	16
44	220	9	44	228	21	44	236	22	44	251	26	44	279	29	44	285	17
44	295	2	44	300	5	44	315	11	44	340	18	44	355	31	44	371	13
44	386	28	44	392	28	44	408	2	44	438	0	44	461	0	44	469	0
45	6	3	45	14	15	45	31	6	45	34	31	45	51	0	45	63	9
45	79	1	45	86	13	45	98	1	45	109	0	45	116	0	45	121	27
45	137	2	45	156	28	45	160	2	45	173	0	45	180	22	45	187	26
45	204	7	45	219	10	45	238	6	45	250	29	45	257	9	45	272	23
45	291	11	45	301	0	45	310	7	45	321	3	45	339	13	45	355	21
45	371	27	45	384	31	45	407	5	45	428	23	45	467	0	45	475	0
46	2	7	46	8	0	46	31	2	46	34	23	46	49	1	46	62	4
46	77	7	46	83	16	46	98	0	46	109	30	46	117	0	46	124	22
46	137	10	46	150	17	46	159	8	46	183	4	46	189	4	46	203	0
46	222	29	46	239	11	46	244	26	46	254	8	46	267	21	46	273	0
46	294	0	46	302	2	46	304	14	46	326	3	46	339	2	46	355	0
46	370	7	46	384	6	46	403	7	46	423	26	46	435	0	46	473	0
47	0	8	47	14	0	47	29	3	47	32	24	47	55	1	47	60	5
47	75	8	47	81	17	47	96	1	47	107	31	47	115	1	47	122	23
47	143	10	47	148	18	47	157	9	47	181	5	47	187	5	47	201	1
47	220	30	47	237	12	47	242	27	47	252	9	47	265	22	47	279	0
47	292	1	47	300	3	47	310	14	47	324	4	47	337	3	47	353	1
47	368	8	47	390	6	47	401	8	47	421	27	47	433	1	47	479	0

Claims

1. A digital communications receiver (103; 400) or transmitter (101; 300) employing an LDPC code selected from rates including ¼, 2/5, 1/2, 3/5, 2/3, ¾, 4/5, 5/6, 13/15, 9/10.

2. The digital communications receiver (103; 400) or transmitter (101; 300) of claim 1, wherein:

an LDPC code of the rate ¼ has a bit node degree distribution, (b_2,b_3,b_6) = (11264,256,3840),
an LDPC code of the rate 2/5 has a bit node degree distribution (b_2,b_3,b_4,b_{12}) = (8960,256,4608,1536),
an LDPC code of the rate 1/2 has a bit node degree distribution (b_2,b_3,b_4,b_{12}) = (7424,2304,3840,1792),
an LDPC code of the rate 3/5 has a bit node degree distribution (b_2, b_3, b_4, b_{12}) = (5888,3328,4352,1792),
an LDPC code of the rate 2/3 has a bit node degree distribution (b_2, b_3, b_4, b_{12}) = (4864,4096,4864,1536),
an LDPC code of the rate 3/4 has a bit node degree distribution (b_2,b_3,b_4,b_{12}) = (3584,4608,5888,1280),
an LDPC code of the rate 4/5 has a bit node degree distribution (b_2,b_3,b_4,b_{12}) = (2816,5888,5376,1280),
an LDPC code of the rate 5/6 has a bit node degree distribution (b_2, b_3, b_4, b_{10}) = (2304,4608,6912,1536),
an LDPC code of the rate 13/15 has a bit node degree distribution (b_2, b_3,b_4,b_7) = (1792,5632,6912,1024), and
an LDPC code of the rate 9/10 has a bit node degree distribution (b_2, b_3, b_4) = (1280,3584,10496).

3. The digital communications receiver (103; 400) or transmitter (101; 300) of claim 1, wherein:

an LDPC code of the rate ¼ is a rate-1/4 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{1}{4}}$,

an LDPC code of the rate 2/5 is a rate-2/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{2}{5}}$,

an LDPC code of the rate 1/2 is a rate-1/2 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{1}{2}}$,

an LDPC code of the rate 3/5 is a rate-3/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{3}{5}}$,

an LDPC code of the rate 2/3 is a rate-2/3 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{2}{3}}$,

an LDPC code of the rate 3/4 is a rate-3/4 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{3}{4}}$,

an LDPC code of the rate 4/5 is a rate-4/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{4}{5}}$,

an LDPC code of the rate 5/6 is a rate-5/6 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{5}{6}}$,

an LDPC code of the rate 13/15 is a rate-13/15 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{13}{15}}$, and

an LDPC code of the rate 9/10 is a rate-9/10 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{9}{10}}$.

4. The digital communications (103; 400) or transmitter (101; 300) of claim 1, wherein:

an LDPC code of the rate ¼ is a code equivalent to a rate-1/4 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{1}{4}}$,

an LDPC code of the rate 2/5 is a code equivalent to a rate-2/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{2}{5}}$,

an LDPC code of the rate 1/2 is a code equivalent to a rate-1/2 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{1}{2}}$,

an LDPC code of the rate 3/5 is a code equivalent to a rate-3/5 LDPC code defined by a parity check matrix

expanded from a base matrix $B_{\frac{3}{5}}$,

an LDPC code of the rate 2/3 is a code equivalent to a rate-2/3 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{2}{3}}$,

an LDPC code of the rate 3/4 is a code equivalent to a rate-3/4 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{3}{4}}$,

an LDPC code of the rate 4/5 is a code equivalent to a rate-4/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{4}{5}}$,

an LDPC code of the rate 5/6 is a code equivalent to a rate-5/6 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{5}{6}}$,

an LDPC code of the rate 13/15 is a code equivalent to a rate-13/15 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{13}{15}}$, and

an LDPC code of the rate 9/10 is a code equivalent to a rate-9/10 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{9}{10}}$.

5. A digital communications system comprising the receiver (103; 400) or transmitter (101; 300) of one of claims 1 to 4.

6. The digital communications system claim 5, wherein the digital communications system is a video broadcasting system.

7. A computer-readable medium storing a computer program for performing a method comprising generating an LDPC code selected from rates including ¼, 2/5, 1/2, 3/5, 2/3, ¾, 4/5, 5/6, 13/15, 9/10.

8. The computer-readable medium of claim 7, wherein:

an LDPC code of the rate ¼ has a bit node degree distribution, (b_2,b_3,b_6)=(11264,256,3840)
an LDPC code of the rate 2/5 has a bit node degree distribution (b_2, b_3, b_4, b_{12}) = (8960,256,4608,1536),
an LDPC code of the rate 1/2 has a bit node degree distribution (b_2,b_3,b_4,b_{12}) = (7424,2304,3840,1792),
an LDPC code of the rate 3/5 has a bit node degree distribution (b_2,b_3,b_4,b_{12}) = (5888,3328,4352,1792),
an LDPC code of the rate 2/3 has a bit node degree distribution (b_2, b_3, b_4, b_{12}) = (4864,4096,4864,1536),
an LDPC code of the rate 3/4 has a bit node degree distribution (b_2,b_3,b_4,b_{12}) = (3584,4608,5888,1280),
an LDPC code of the rate 4/5 has a bit node degree distribution (b_2, b_3, b_4, b_{12}) = (2816,5888,5376,1280),
an LDPC code of the rate 5/6 has a bit node degree distribution (b_2,b_3,b_4,b_{10}) = (2304,4608,6912,1536),
an LDPC code of the rate 13/15 has a bit node degree distribution (b_2, b_3, b_4, b_7)= (1792,5632,6912,1024), and

an LDPC code of the rate 9/10 has a bit node degree distribution (b_2,b_3,b_4) = (1280,3584,10496).

9. The computer-readable medium of claim 7, wherein:

an LDPC code of the rate ¼ is a rate-1/4 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{1}{4}}$,

an LDPC code of the rate 2/5 is a rate-2/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{2}{5}}$,

an LDPC code of the rate 1/2 is a rate-1/2 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{1}{2}}$,

an LDPC code of the rate 3/5 is a rate-3/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{3}{5}}$,

an LDPC code of the rate 2/3 is a rate-2/3 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{2}{3}}$,

an LDPC code of the rate 3/4 is a rate-3/4 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{3}{4}}$,

an LDPC code of the rate 4/5 is a rate-4/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{4}{5}}$,

an LDPC code of the rate 5/6 is a rate-5/6 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{5}{6}}$,

an LDPC code of the rate 13/15 is a rate-13/15 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{13}{15}}$, and

an LDPC code of the rate 9/10 is a rate-9/10 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{9}{10}}$.

10. The computer-readable medium of claim 7, wherein:

an LDPC code of the rate ¼ is a code equivalent to a rate-1/4 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{1}{4}}$,

an LDPC code of the rate 2/5 is a code equivalent to a rate-2/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{2}{5}}$,

an LDPC code of the rate 1/2 is a code equivalent to a rate-1/2 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{1}{2}}$,

an LDPC code of the rate 3/5 is a code equivalent to a rate-3/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{3}{5}}$,

an LDPC code of the rate 2/3 is a code equivalent to a rate-2/3 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{2}{3}}$,

an LDPC code of the rate 3/4 is a code equivalent to a rate-3/4 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{3}{4}}$,

an LDPC code of the rate 4/5 is a code equivalent to a rate-4/5 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{4}{5}}$,

an LDPC code of the rate 5/6 is a code equivalent to a rate-5/6 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{5}{6}}$,

an LDPC code of the rate 13/15 is a code equivalent to a rate-13/15 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{13}{15}}$, and

an LDPC code of the rate 9/10 is a code equivalent to a rate-9/10 LDPC code defined by a parity check matrix expanded from a base matrix $B_{\frac{9}{10}}$.

FIG. 1

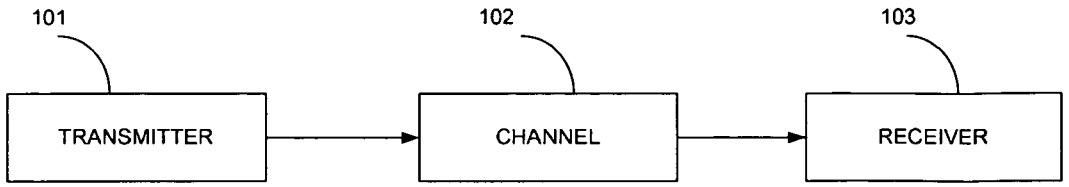

101
102
103
TRANSMITTER
CHANNEL
RECEIVER

FIG. 2

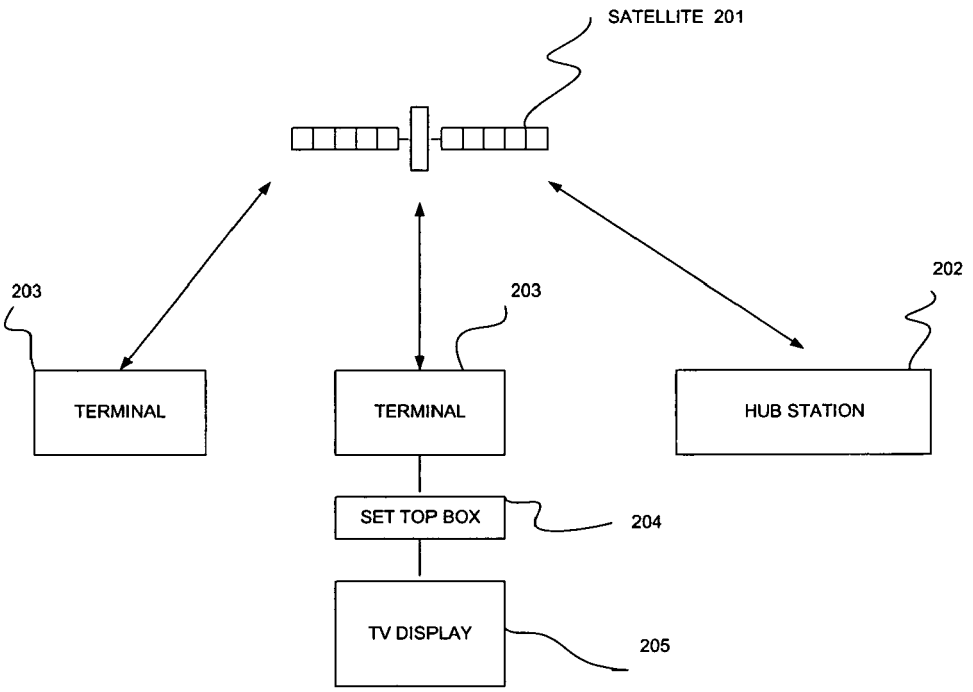
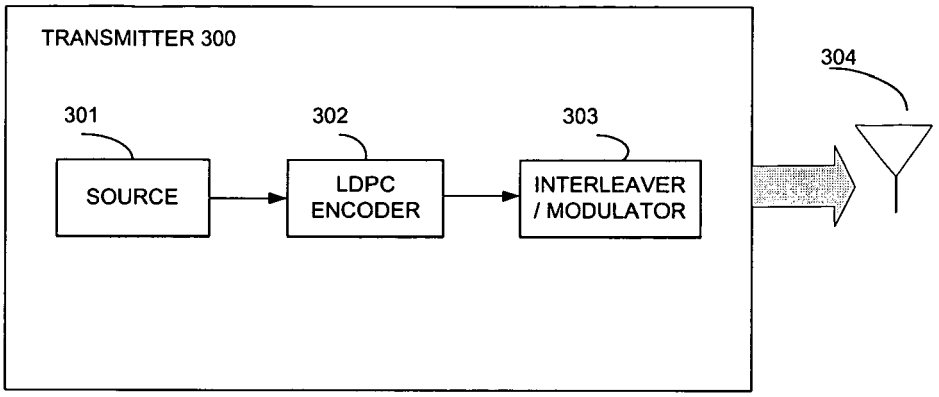

SATELLITE 201
203
203
202
TERMINAL
TERMINAL
HUB STATION
SET TOP BOX
204
TV DISPLAY
205

FIG. 3


TRANSMITTER 300
301
SOURCE
302
LDPC ENCODER
303
INTERLEAVER / MODULATOR
304

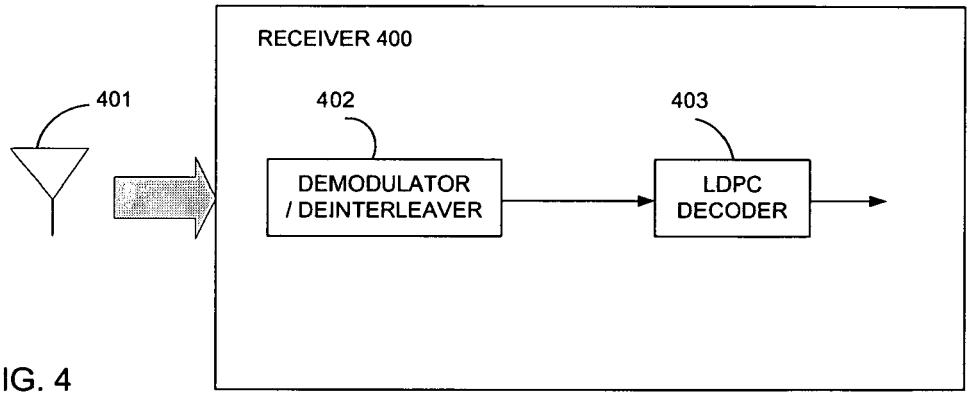

RECEIVER 400
401
402
DEMODULATOR / DEINTERLEAVER
403
LDPC DECODER

FIG. 4

FIG. 5

$$H = \begin{bmatrix} 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 & 1 \end{bmatrix}$$

FIG. 6

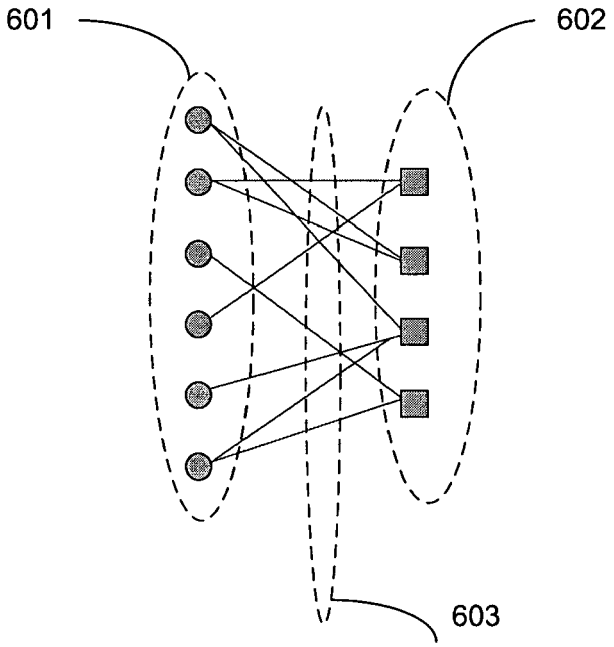


FIG. 7

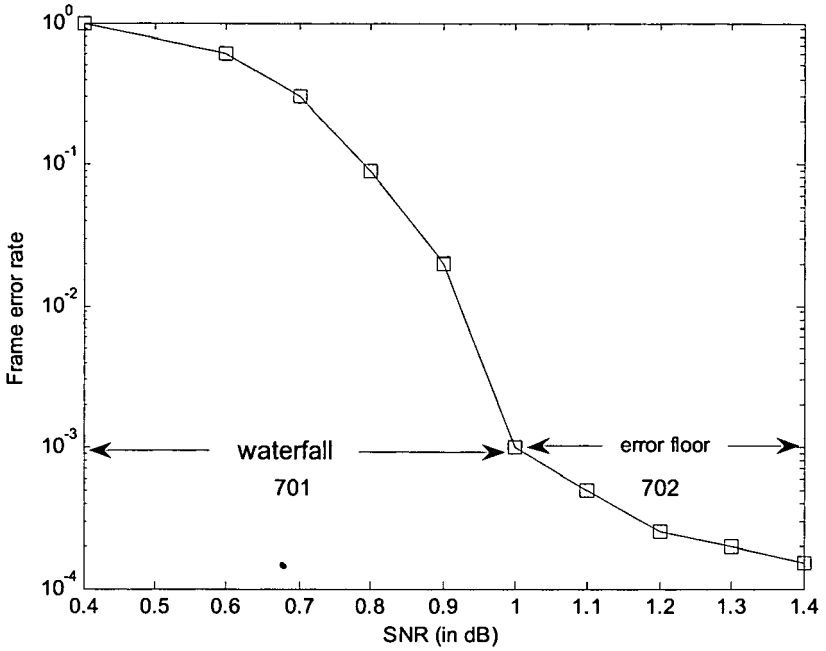

Frame error rate
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
waterfall
701
error floor
702
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
SNR (in dB)

FIG. 8

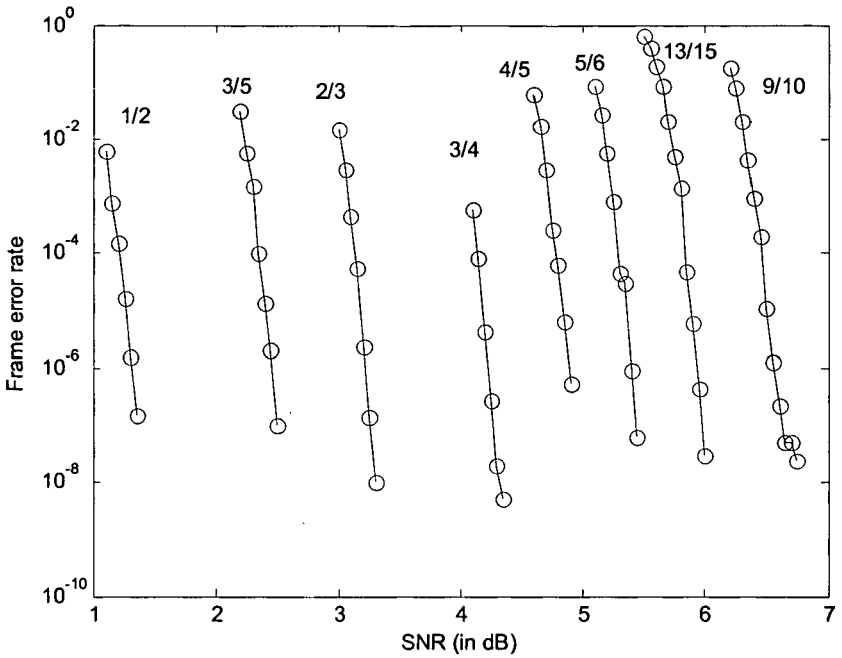


FIG. 9

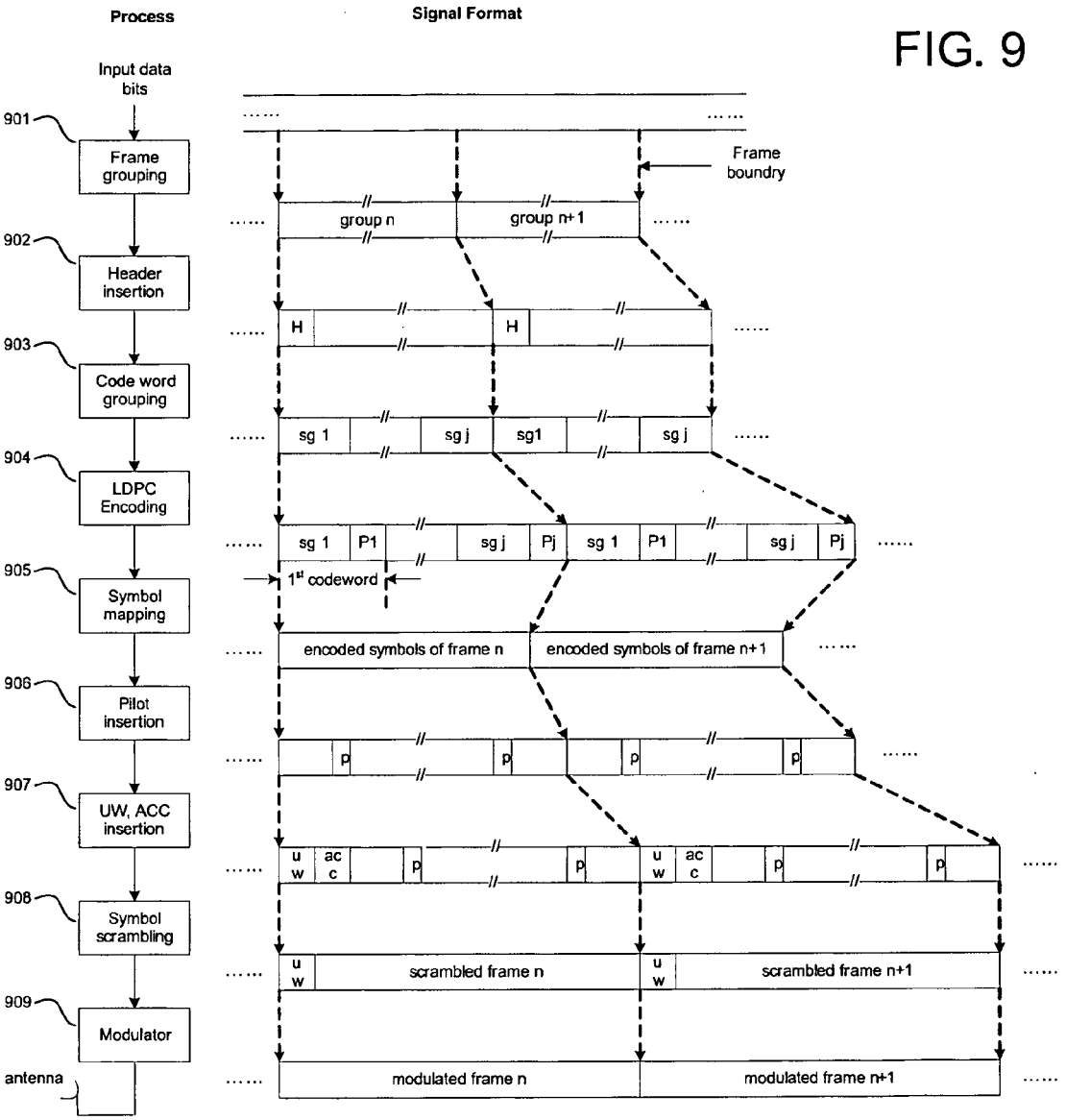
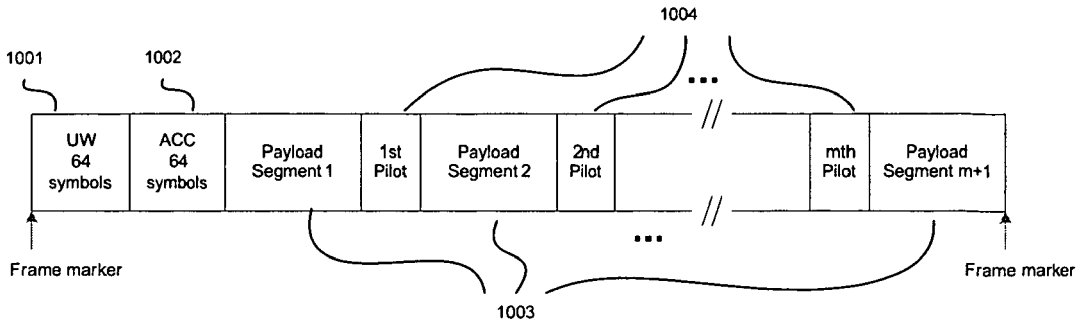

Process
Signal Format
Input data bits
901
Frame grouping
902
Header insertion
903
Code word grouping
904
LDPC Encoding
905
Symbol mapping
906
Pilot insertion
907
UW, ACC insertion
908
Symbol scrambling
909
Modulator
antenna
Frame boundry
group n
group n+1
H
sg 1
sg j
P1
Pj
1st codeword
encoded symbols of frame n
encoded symbols of frame n+1
p
uw
acc
scrambled frame n
scrambled frame n+1
modulated frame n
modulated frame n+1

FIG. 10


1004
1001
1002
UW
64
symbols
ACC
64
symbols
Payload
Segment 1
1st
Pilot
Payload
Segment 2
2nd
Pilot
mth
Pilot
Payload
Segment m+1
Frame marker
Frame marker
1003

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 01 6672

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	YADAV M K ET AL: "Design and Implementation of LDPC Codes for DVB-S2" PROC., IEEE 39TH ASIMOLAR CONFERENCE ON SIGNALS, SYSTEMS AND COMPUTERS, PACIFIC GROVE, CALIFORNIA, 28 October 2005 (2005-10-28), - 1 November 2005 (2005-11-01) pages 723-728, XP010900097 ISBN: 1-4244-0131-3 * the whole document *	1,3-7,9, 10	INV. H03M13/11
A		2,8	

X	EUROPEAN BROADCASTING UNION UNION EUROPÉENNE DE RADIO-TÉLÉVISION EBU-UER; ETSI EN 302 307: "Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications" ETSI STANDARDS, EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE, SOPHIA-ANTIPOLIS, FR; ETSI EN 302 307, no. V1.1.2, June 2006 (2006-06), pages 1-74, XP014034070 ISSN: 0000-0001 * page 13; figure 1 * * page 21 - page 23 * * page 58 - page 60 *	1,3-7,9, 10	TECHNICAL FIELDS SEARCHED (IPC) H03M
A		2,8	

X	US 2005/271160 A1 (EROZ MUSTAFA [US] ET AL) 8 December 2005 (2005-12-08) * paragraph [0046] - paragraph [0092] *	1,3-7,9, 10	
A		2,8	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 November 2007	Offer, Elke

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005271160 A1	08-12-2005	NONE	

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- **T. RICHARDSON ; R. URBANKE.** The Renaissance of Gallager's Low-Density Parity Check Codes. *IEEE Communications Magazine,* August 2003, vol. 41, 126-131 **[0004]**
- **C. BERROU.** The Ten-Year-Old Turbo Codes are entering into Service. *IEEE Communications Magazine,* August 2003, vol. 41, 110-117 **[0004]**
- **T. RICHARDSON ; M. SHOKROLLAHI ; R. URBANKE.** Design of capacity-approaching irregular low-density parity-check codes. *IEEE Trans. Inf. Theory,* February 2001, vol. 47, 619-637 **[0014]**